Surveying and Mapping

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January — March 1958

Quarterly Journal

AMERICAN CONGRESS ON SURVEYING AND MAPPING

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Howard S. Rappleye,

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OF SURVEYING AND MAPPING

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January–March 1958

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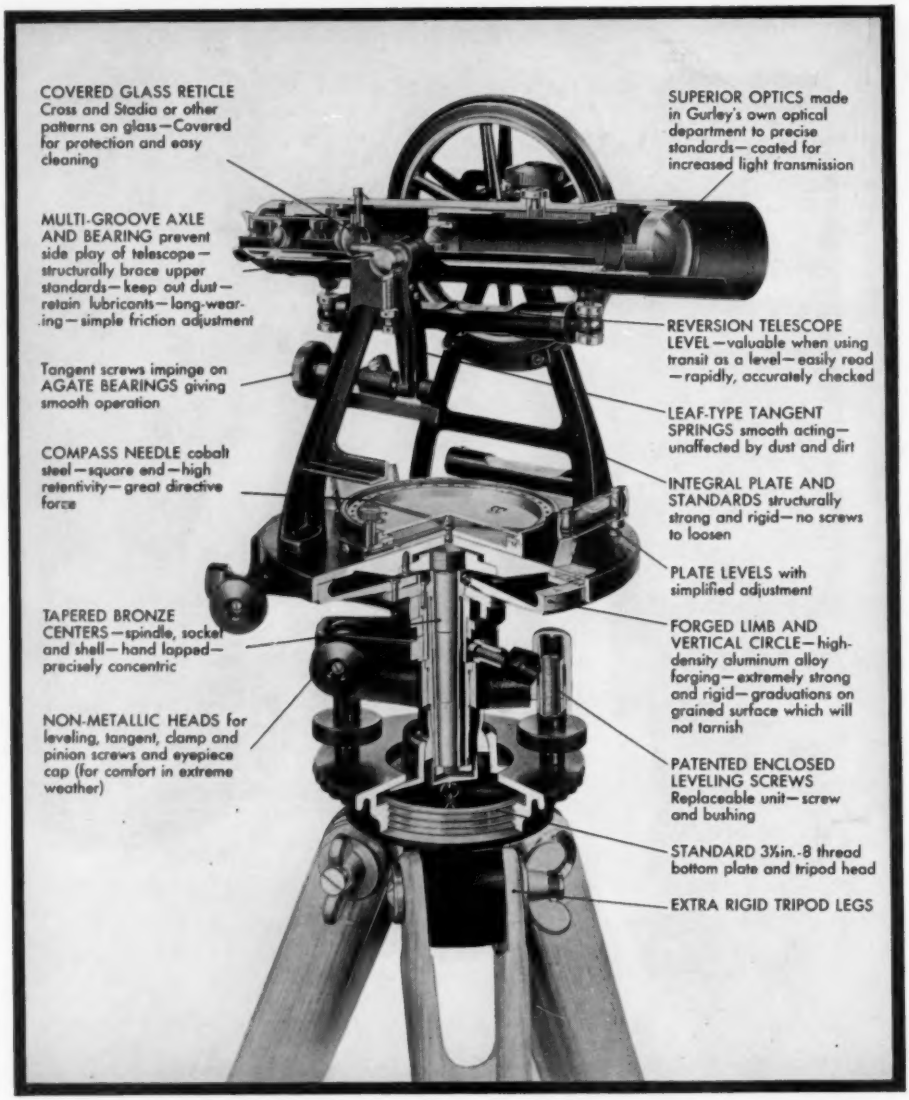
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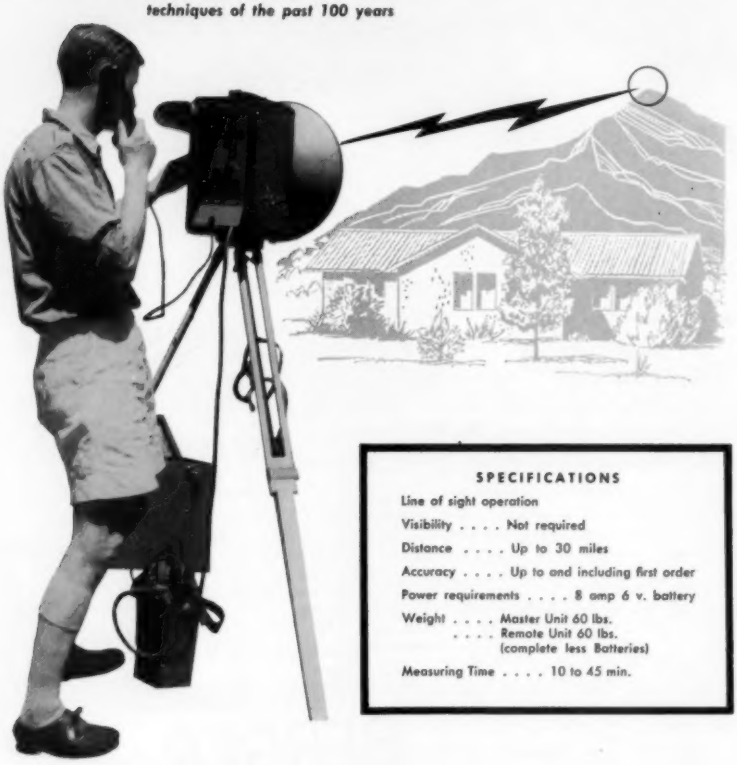

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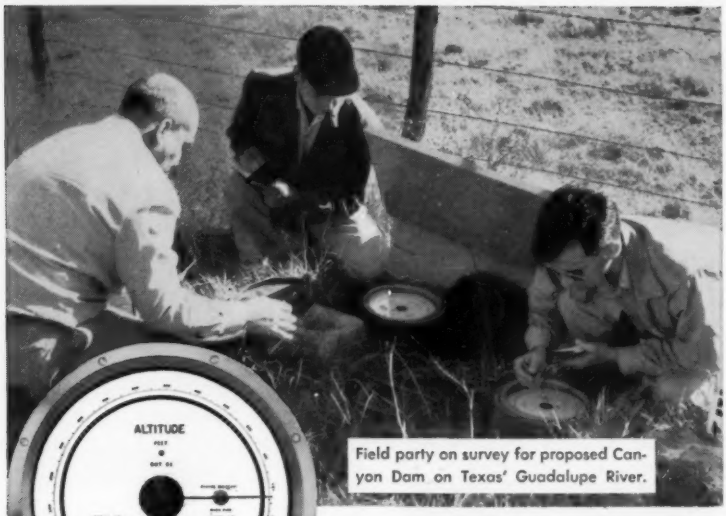

Field party on survey for proposed Canyon Dam on Texas' Guadalupe River.

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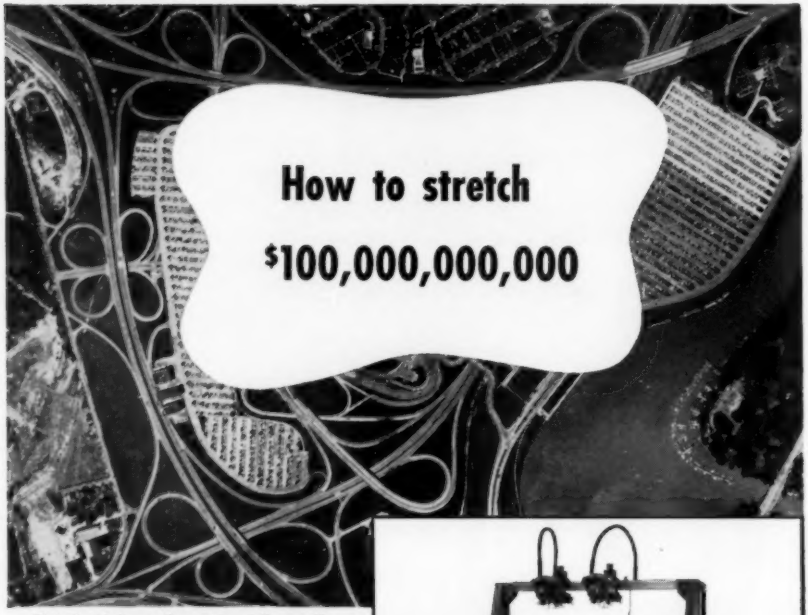

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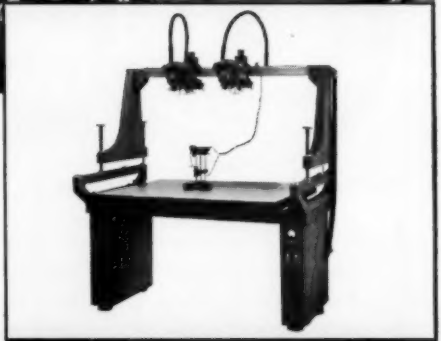

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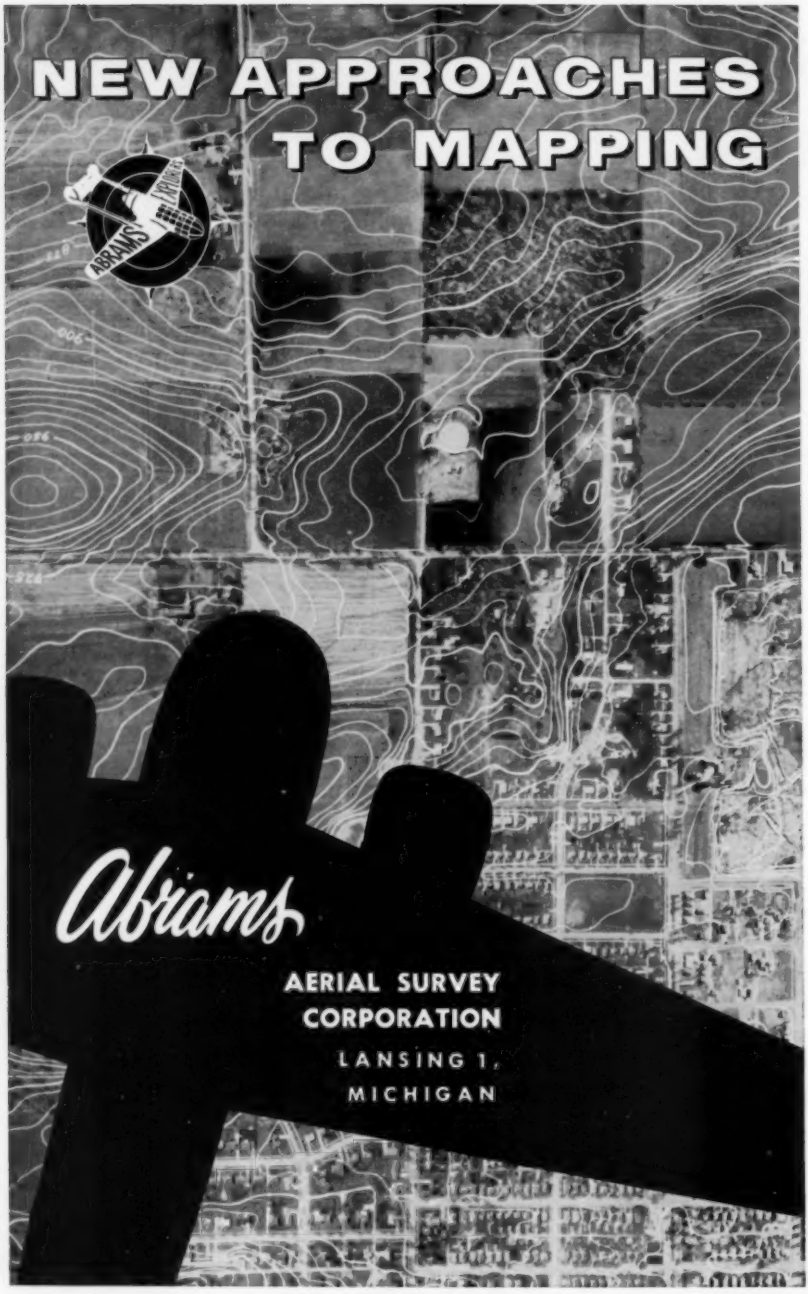
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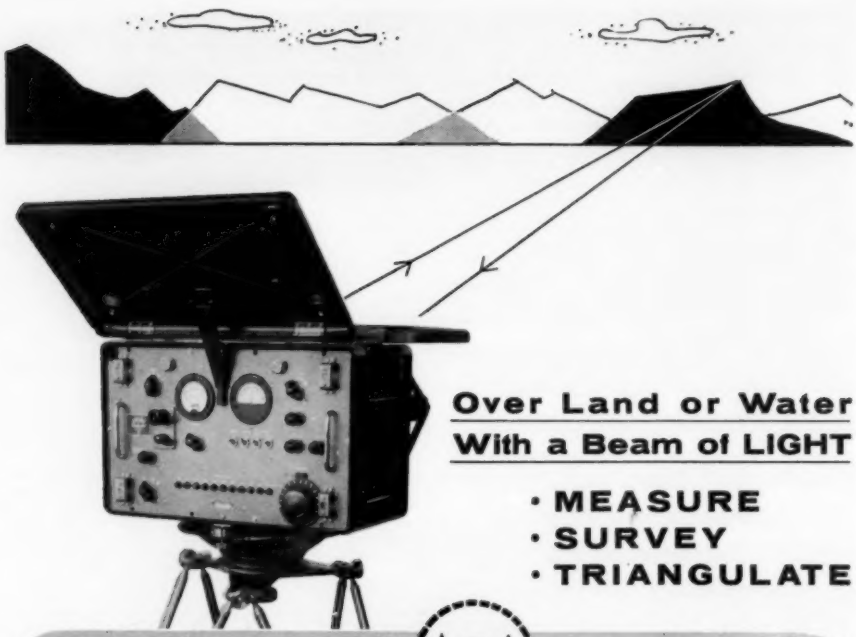

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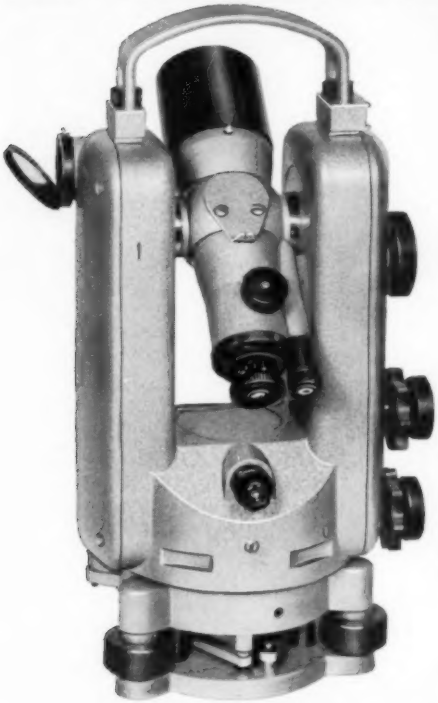

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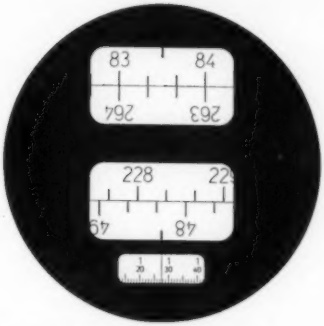

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The Education of the Land Surveyor
(A Panel Discussion)

EDITOR'S NOTE:—At the Seventeenth Annual Meeting of the American Congress on Surveying and Mapping, March 6–8, 1957, a combined panel from the Property Surveys and Education Divisions of ACSM discussed "The Education of the Land Surveyor" from a variety of viewpoints. Prof. Harmer A. Weeden, Associate Professor of Civil Engineering, The Pennsylvania State University, served as moderator. The panel included: James L. Bell, P.E., L.S., James L. Bell and Company, Kansas City, Mo., and Denver, Colo.; Prof. Ralph Moore Berry, Professor of Geodesy and Surveying, University of Michigan; Prof. Lawrence Perez, Professor of Civil Engineering, The Pennsylvania State University; W. B. Williams, P.E., L.S., Williams and Works, Grand Rapids, Mich.; and Prof. Sumner B. Irish, Associate Professor of Civil Engineering, Princeton University. The following five papers are published as a unit and cover the complete panel discussion of Wednesday, March 6, 1957.

The Land Surveyor from the Standpoint of an Employer of Land Surveyors and Engineers

By JAMES L. BELL

APPEARING with this very distinguished group of four educators on this panel, it is probably fitting that at least one panel member be four times as unqualified to discuss this subject of education as are the other panel members; therefore, I appear here in the interest of "good balance."

I would not presume to be qualified to discuss the subject of education itself, but would make a few comments concerning this matter of education of surveyors, particularly education of land surveyors, and would make these comments from the standpoint of a professional land surveyor and an employer of land surveyors.

In approaching this subject of education, I believe that it is first necessary to establish the need for education of land surveyors and to establish the fact that education for land surveyors is not now adequately being provided. It would seem to me that the best judges of the qualifications needed for the land surveying profession would be the experienced land surveyors themselves. Certainly the most outspoken and active critics of land surveying are "competing land surveyors." If you do not believe this, simply set a stake and watch until the next land surveyor comes along and checks it out. He will spend a lot of his own time being critical and studying and measuring into that survey, whether it is any of his business or not. One time I wasted almost half a day trying to check what later proved to be a horseshoe peg.

Then, if the land surveyor's opinion of qualification is to be respected, I say to the educators of this country that many land surveyors do not feel that you are teaching enough of the "basic legal and practical information" in your surveying courses. We, as employers, cannot normally use your students or graduates for any immediate purpose in land surveying until they have had definite further experience and instruction. We find that the average student or engineering graduate has a good background in the instruments involved and in survey calculations, but that he has very little knowledge of legal descriptions, their interpretation, their construction, or their comparative meaning. We not only find that we are not able to deal with him immediately as an employee, but that we cannot respect the surveying student's or engineer's work as a competing land surveyor

until such time as he has gained extensive experience and additional information. I mention these facts with no intention of being critical of the engineering profession or the educators of engineers but to bear out the point that there is a definite need for more thorough basic education in land surveying and that it is not now being provided. If it were being provided, then, as employers, our problems would be very, very simple. It is comparatively simple to hire an engineer, but it is almost impossible to employ a good land surveyor without training him in your own organization.

I have heard it stated in our Congress in years past that it is not worthwhile to train engineers as surveyors. I seriously question that statement. In the first place, many engineers prefer to enter fields where eventually they will do extensive surveying or will direct those people who are responsible for that surveying. In order to properly evaluate land surveying or direct it, I feel that they should know something more about the fundamental elements of the subject. It has been stated at our meetings that engineers could not afford to train as surveyors because of the limited income to surveyors. I would like to suggets that I am talking to a group of surveyors this moment whose average income is just as high or higher than their neighboring engineers who are in business for themselves and who run comparatively the same size organization, so I do not think the monetary return is a matter of importance.

In terms of the need of this education, I suggest that the public itself is in need of it and deserves it. There are many trains of thought in this country which put the civil engineer in a position such that the public feels (and in many cases the engineers feel) that the engineer is really more qualified to do land surveying than is the land surveyor himself. This thinking is emphasized by the license boards in many States. In some States there are no provisions for licensing a land surveyor, but it is necessary to be licensed as a civil engineer in order to be respected as a land surveyor. In other States the civil engineer is automatically given a Land Surveyor's License after a number of years of any type of experience, and there are States in which there are more stringent restrictions which truly set the land surveyor apart from the engineer. I would suggest that colleges are not being fair to either the public or the engineering student unless they give him at least enough of the legal elements and practical side of land surveying to enable him to do the work and impress him with his need for obtaining more information through experience in a given locality before he offers his service as a land surveyor. I would suggest specifically that this be done in two ways:

1. By simply expanding the present surveying curriculum to include the basic legal elements of land surveying, the intention being to impress the student with the fact that there are complex surveying problems. He must learn by local experience and contact.

2. A truly complete land surveying course should be offered in the first two years of college. This will be taken advantage of by those people who are interested particularly in practicing surveying and especially those who do not foresee the ability to finish college. Such a complete course would equip a two-year college man with the proper knowledge of instruments, the proper basic knowledge of legal descriptions and other problems peculiar to land surveying in such a manner that he could step out into the world and do a good job as a land surveyor.

I would suggest in closing that, if the colleges are unable, or do not feel that it is practical, to offer a more complete course in land surveying, then *please,* gentlemen, impress the student with the fact that he will need to get extensive experience in land surveying in a given area before he should offer his services as a land surveyor. For this, the land surveyors and the public will thank you.

Is Education for the Professional Land Surveyor to be Accomplished Within the Framework of the Civil Engineering Curriculum?

By RALPH MOORE BERRY

AT ANY convention or conference attended by a number of professional surveyors, the subject of professional education is invariably discussed—at length, but in circles so that there seems to be little progress and no conclusions. In view of this discouraging precedent, and fully cognizant of the pitfalls, I hesitate to add more verbiage to the enormous total already contributed by the many eminent practitioners and educators who have preceded me.

The problem seems to center on the alleged fact that in order to practice land surveying, a man must be endowed with an esoteric and mystical sense, a hidden insight, inspired by a "call," almost in the sense of a religious "vocation," that enables him, by the use of measurements that never conform to the facts of possession or the positions of undeniably authentic monuments, to assert and maintain that, in his opinion, a certain boundary line must be in such-and-such particular location, and confusion to him that questions it. This opinion comes from the study of musty documents, genealogical records, local history, familiarity with the habits of his predecessors, digging and delving for old rotted stumps and stakes, et cetera, et cetera, and et cetera. It is further alleged that the universities are not now, nor in recent decades, attempting to train eager young men to complete competency in these skills of the spirit. The plain fact of the matter is that the proper resolution of the confusing data that appear under such circumstances is only forthcoming as the result of extensive and direct personal experience at a professional level from which is developed a background in the practice of the art. The complaint is, therefore, largely directed to the lack of this inner sense. That this lack exists is undeniable, but it is also undeniable that no university can give a course in background. It can only inspire the background to acquire background. It may well be that there are abysmal failures to accomplish even this. If these failures result from a lack of perception of the problem or a weakness in the spirit of inspiration, then it may properly be asserted that the university is derelict in its duty. The present tendency toward "practicality" in modern curricula may well be the source of such failures as exist.

The foregoing seems to be beside the point. It is only introduced to point up the problem. The fact remains that, at present, the only direct source of formal education for the surveyor is at the university, and, specifically, in the civil engineering curriculum. The additional undeniable fact remaining is that considerable dissatisfaction exists with this situation. Why does this dissatisfaction exist; and what can be done about it?

It is noteworthy that, as a result of this dissatisfaction, there has been a widespread but unorganized rebellion, the manifestations of which have been diametrically opposed. On the one hand, there has been a tendency to recruitment from other curricula than civil engineering, and, on the other hand, to a complete abandonment of formal education and a reversion to the apprentice system.

Recruitment from other curricula does not follow logically. One complaint is that, in civil engineering, we do not teach enough surveying; that we are not devoting enough time to the "practical" side; that our graduates are not qualified as skilled instrument, computing, or drafting technicians. If this be the real complaint, what other curriculum will better satisfy this requirement? Another complaint is that civil engineering graduates lack what is called "instrument feel" and "computing sense," which may be more formally defined as a lack of under-

standing of the basic theories of measurement. These critics say that if we give them graduates with the proper background in mathematics and measurement theory, a knowledge of techniques in specific areas is unessential. This knowledge will be imparted to the recruit by the specialists that are available within the organization. If there is a basis for this latter complaint, it is real cause for criticism; but only for criticism of detailed applications. If civil engineering be properly taught and its curriculum logically arranged both for content and presentation, there will be no cause to complain of lack of mathematics and understanding of measurement theory. There are both time and demand for these, even to the extent required in surveying, within the civil engineering curriculum.

The movement toward the apprentice system gives particular cause for concern. Although this system served in the past, it is not the present-day approach toward professional education. It serves admirably for the training (note that I have not used the word "education") of plumbers, but fails miserably as a means of inspiring original thinking which, in the final analysis, is the true product of a profession. The apprentice system makes no provision for extended instruction in such subjects as mathematics and basic science. The practitioner on whom falls the responsibility for training under the apprentice system is seldom qualified to instruct adequately in these abstract subjects, seldom has the time available to devote to adequate instruction, and is usually inclined to be scornful of any material not directly applicable to the techniques of practice in his own office. This produces an atmosphere that is conducive to the learning of techniques, "tricks," "short cuts," etc., which, while essential to the assembly-line production of the modern surveying office, are not formative of the background and thinking habits to produce a new generation of professional men.

A recent variation of the apprentice system, which is perhaps an improvement but subject to the same basic objection, is the trend toward the "technical institute." This is an educational institution where training is imparted by the professional teachers (thus overcoming some of the objections to the apprentice system) but the training extends over a shortened period, usually two years, instead of the four years (minimum) presently devoted to the bachelor's curriculum in engineering. The training is, of necessity, confined to an exposition of the techniques of surveying without being able to devote much time to background material. Thus, it is subject to the same deadly criticism as the apprentice system—that it is not productive of the inspiration to original, independent thinking but, instead, produces a "handbook" type of practice.

The foregoing criticisms of both the apprentice system and the technical-institute idea would not be valid if both systems were directed solely to the training of surveying technicians, instrumentmen, computers, draftsmen, etc., who are sorely needed today. In modern practice, the principal practitioner of the firm does not make all measurements, compute his own data, and double as his own draftsman. He is increasingly dependent on a large crew of technicians, each expert in his own speciality, to perform many of the operations essential to his practice. The final product, however, is the result of his personal interpretations of the data produced by the technicians and for which he, alone, is responsible. No amount of technical manipulative skill will stand as the equivalent of the judgment and creative thinking thus required. If it is realized that, in general, these systems will only produce the technicians who must not consider themselves as candidates for professional registration, a valid requirement for them will have been established without criticism.

The practice of a profession requires an extensive technical background in a particular discipline and the exercise of considered judgment in the solution of its problems. The technical background is acquired through a prolonged course of study, usually at university level, enhanced by the cumulative experience of succeeding years of practical, applied, progressively-difficult work. In the exercise of judgment, there is no set of rules to guide its application, and

the subject matter is so technical that it is not possible for the average client to judge the competency of the practitioner or the adequacy of his solution. It is probable that few will disagree with these principles or with the association of the practice of surveying with them. However, it is believed that many surveyors, while stoutly maintaining that surveying is a profession, are working toward its ultimate exclusion as such. If this should occur, the profession will have only its own members and their myopic thinking to blame.

Let us consider the history of the land-surveying profession in the United States. To a far greater extent than other professions, it has been plagued by a cyclic sequence of feast and famine—a series of importunate demands for its services interspersed with doldrum periods. A large part of the demand has been by the Federal government while engaged in the tremendous undertaking of surveying the public lands as a *sine qua non* precedent to their sale to the public in parcels of consistent and usable size. Although scientific knowledge and the instrument-makers' craft had, even at the beginning of this period, progressed to the point that it was possible to do work of geodetic accuracy, the rules and regulations for the survey of the public lands were written by the politicians, not by the surveyors. With typical "penny-wise and pound-foolish" policies, they required surveying services in quantity far exceeding the available technical talent and put the entire system out to contract without accuracy specifications and without adequate inspection, and established by legislation that the rate of pay would be two dollars per mile actually run—later increased to the magnanimous rate of three dollars per mile! Few and far-between were the competent surveyors who would contend with wild country and wild Indians for this rate of pay! The result was that the ignorant farmers, lumberjacks, and just plain adventurers did a large part of the work. Accuracy was very low and many surveys were incompletely or fraudulently accomplished. This, for a period of approximately a century (the contract system was abolished in 1910), was the picture that the average landholder had of our profession. Another period of great demand occurred during the days of the "New Deal" when the federally-sponsored housing program took form. Again, the demand for services exceeded the supply and, although registration laws helped in some areas, many surveys were made by incompetent and unscrupulous operators. Thus, to the new urban homeowner plagued by boundary disputes, our profession acquired a reputation for being inaccurate, irresponsible, and having the collective ethics and commercial instincts of a group of inmates of a rug market. We have made much progress in the last twenty years. We have licensing; and State and local organizations that promulgate technical standards and codes of ethics. A large part of the credit for this progress should be directed to this great national conference, colloquium, and source of inspiration—the American Congress on Surveying and Mapping, founded in 1941.

So far, this discourse has had much of the "Dutch Uncle" aspect, although critical only where necessary to develop thinking, and never with the intention of being personal or unconstructively derogatory. Situations have been explored and deplored. It is now necessary to produce something constructive.

A start will be made by examining the basic principles of the registration laws. No particular State is singled out, and there are probably individual exceptions to all the generalities posed herein. The registration laws are justified on the basis of the protection of the general public. Only incidentally do they also protect the profession and the individuals engaged in it. Primarily they were written around the professional engineer. The land surveyors were included as a splinter group. At the time that the phraseology of the laws was developed, the work of the land surveyor was largely confined to the re-tracement of the previously established section lines or other system for the delineation of rural property lines. A high degree of technical skill or broad engineering competence was not required. Because the original surveys were highly in-

accurate, high accuracy in re-tracement was never considered. Therefore this work was not considered to be included within the area of engineering, and the legal definitions were so written. Most of the laws on the books today define land surveying as the "establishment or re-establishment of land boundaries and subdivisions thereof. . . ." By implication, the definition of professional engineering includes any other operations that involve an engineering measurement—topographic mapping, route surveying, study of drainage areas; to mention a few.

How many surveyors today make their living by the re-tracement of boundaries? An estimate is that less than 25 per cent of the average surveyor's dollar volume today is made by re-tracement! Therefore, the plain fact is that today the surveyor must be competent in the engineering field in order to stay in business. He cannot design a subdivision without first making a topographic map. He must consider street grades, drainage areas, storm sewer design, traffic studies, zoning, impact on local economy, recreation, parks, schools, *ad infinitum*. If he is licensed only as a land surveyor, he must, under the law, perform only the boundary survey, leaving the rest to a registered professional engineer.

Now, in conclusion and as a recommendation for action to improve the situation, we submit that education for the professional surveyor (land surveyor or other specialist) can only be accomplished within the framework of the civil engineering curriculum. If we are to continue as a profession and raise our position in the public esteem, we must abandon the practice of licensing land surveyors separately, with practically no formal educational requirements, and consider land surveying as a specialty within the area of civil engineering. Some will object that engineers as graduated from the university are not qualified in land surveying. Neither are they qualified to design bridges or sewer systems, but they have the background to acquire competency through extended practice. There is little difficulty at present between other specialties. A firm specializing in sewer design seldom accepts assignments in the structural field. The laws generally do not prohibit a registered civil engineer from designing electric transmission lines or chemical processes, but no problem is presented thereby because professional ethics forbid him from accepting work in areas in which he is not competent. Why should land surveying be different?

It is realized that the above suggestion is, at present, somewhat Utopian. Surveying must be accepted as a specialty field within civil engineering, on a par professionally and technically with structural design, transportation engineering, or water development and utilization. This will require a revision of attitude by practicing engineers and university faculties. This will not be forthcoming as long as we insist on the archaic distinction of the land surveyor as a separate law unto himself. Without injuring those now practicing, we must raise our standards to full stature as engineers and institute formal educational requirements. There is little objection to formal educational requirements for lawyers and physicians, where it is impossible to take the State examinations without first having university training. Why should engineering be different?

Further, surveying instruction must be changed. A professional outlook will not be imparted to the students if surveying is taught in "hand-book" style by immature and unenthusiastic beginning instructors who have stronger interests in other specialties. Surveying must be taught by men of higher rank who have appointments to teach surveying. Most of these instructors of higher rank should be appointed after an extended experience in some field of surveying rather than be appointed to the faculty immediately after graduation. A correlative of this is that every instructor should be employed in the professional surveying field at least one out of every three summers. This employment should be on a selective basis with firms where he will have the opportunity to keep abreast of improvements and innovations rather than to be on routine production assignments.

Finally, if surveying is to attain status as a specialty, it should be possible for the un-

dergraduate student, if he chooses, to devote some time to the study of advanced surveying, above and beyond the fundamental courses required of all civil engineering students. This is now possible at the University of Michigan under the regular program where all students in civil engineering are required to take ten semester hours in surveying, thirteen in structures, and ten in hydrology and other subjects relating to water. In addition, he must elect another nine semester hours in one of the specialty areas such as construction, structures, highways, sanitation; and one of these areas is that of geodesy and surveying. In this combination, a student can complete the curriculum with a broad basic training in mathematics and science, a normal coverage in structures and hydraulics, but with a total of nineteen hours in geodesy and surveying. This will be adequate preparation for the professional engineering examination and will also provide a fairly extensive background in surveying. If, after this, the student lacks "instrument feel" and "computing sense" the fault lies in our understanding of the basic theories of measurement of student capacities and not in the failure of the curriculum to provide the opportunity.

The State University Offers Courses to Surveyors Through Its Extension Division

By LAWRENCE PEREZ

IT WAS with trepidation that I accepted this assignment because I am not completely satisfied with our attempt to solve the immediate problem, and it is depressing to hear essentially the same things repeated over and over again in regard to the status of surveying in the university curriculum. In some respect, I am reminded of a friend who, after devoting the better part of his life to research on the respondence of animals to sonic impulses, was remanded to an institution for rehabilitation. His apparent recovery was phenomenal, and, after a few treatments, he was allowed to have visitors. During one of my visits, he produced a flea and informed me that he had made a wonderful discovery. He then proceeded to put the flea on his arm and snapped his fingers twice. At each snap, the flea jumped, demonstrating the reaction of the flea to sound. My friend then picked up the flea and plucked each of its hind legs and returned it to his arm. Again, he snapped his fingers twice, but, needless to say, the flea did not jump. My research friend, with great enthusiasm, then exclaimed, "See, by removing the flea's hind legs, I have destroyed his hearing."

On Saturday, March 2nd, Wilfred D. Gillen, President of Bell Telephone Company of Pennsylvania, addressed 2,000 people at the annual Secondary Education Board dinner and voiced the fear that the United States may follow the Russians by overemphasis on specialization and technical training. He also expressed the fear that the United States might "overlook the need to balance our technical progress with the development and training of the overall man."

Even though we can appreciate his concern, I still believe that the philosophy of most of our universities is to graduate men with a broad experience base and then leave the job of specialized training to industry. In this highly competitive world, the survival of our social system depends on the efficiency and scope of our technological manpower team. This team made up of scientists, engineers, and engineering aides or technicians is in constant need of replacements. The scientists and engineers have been drawn from our many universities while the technicians have usually been trained by industry. Both categories are woefully low in manpower, but of the two

the technician class is the most serious. In our complex society, after the research scientist conceives new ideas, unearths new information, and investigates new interests, the engineer is called upon to create new designs and procedures from the results of the scientist's work. The engineering technicians contribute to the team play by completing the plans, by building, testing, operating, and servicing equipment. Unfortunately, because of manpower deficiency, this aspect of the team work is being performed by engineers who, because of education and background, should be performing at a higher level. This misapplication of manpower can indirectly become detrimental to our national economy.

A recent survey by a committee of the American Society of Engineering Education determined that there is a need for 30,000 to 40,000 four-year engineering graduates each year. However, only about half this number are being graduated. This group determined that the national educational pattern is unbalanced in the development of technicians. Their survey shows that schools are graduating only one-third of the required number of qualified technicians.

We, in surveying, have seen the handwriting on the wall, and have been wailing for many years. The number of graduate civil engineers continuing in surveying and mapping is infinitesimal compared to the other branches of civil engineering. This is true because most of the young men feel they would be prostituting their four-year schooling by following this profession. On the other hand, the surveying industry feels that it is being short-changed with the civil engineering graduate today. This attitude persists because, paradoxically, the faculties of Departments of Civil Engineering are reducing the time allotted to teaching surveying principles and techniques in order to cram into a four-year curriculum special courses which allow the graduates to keep in step with modern technology. At the present rate of depreciation, the teaching of surveying at collegiate levels may soon become as extinct as that bird called the Dodo.

Inasmuch as there is a definite apathy towards the profession by civil engineering graduates, and because the time in a four-year curriculum for the teaching of surveying is inadequate, I would like to suggest some possibilities for alleviating the problem. In making the following suggestions, I recall the young clothing salesman who made a wager that he could legitimately sell the "loudest" sport coat on the rack. He was in charge of the store over the noon-hour. When the owner returned, he found his store a shambles and his salesman a bit the worse for wear. Before the owner came out of shock, the salesman said, "I sold it. I sold that lavender and green coat." "Fine," said the owner, "but haven't I impressed on you never to hard sell or coerce a customer into buying?" "Oh, the customer didn't give me any trouble," replied the salesman, "it was the darn seeing-eye dog!"

Foundrymen, recognizing the need for motivation in a field not usually accepted by university graduates, resolved their problem in a very direct fashion. A Foundry Education Foundation was established by the Foundrymen's Association composed of smaller groups such as American Foundrymen's Society, Foundry Equipment Manufacturers' Association, Gray Iron Founders' Society, Malleable Founders' Society, and others. This group not only grants scholarships amounting to $4,500 at the Pennsylvania State University, but also administers scholarships amounting to $1,150, which are sponsored by firms such as the Luria Brothers, Link Belt Company, and W. B. Coleman. Through these grants, they have been able to attract capable students from the Mechanical Engineering, Industrial Engineering, and Metallurgy curricula. The American Society of Tool Engineers has also moderately acquired a manpower reserve by using the same technique. This group, in addition to granting scholarships, maintains an educational advisory committee which cooperates with universities to the extent of supplying visual aids, speakers, and general information relative to the tool and die industry.

Is there any reason why we in the surveying profession should not emulate the Foundrymen and Tool Manufacturers in spon-

soring scholarships for qualified students interested in the field of surveying and mapping? We are not going to solve our manpower shortage or have the surveying credits increased in the curriculum of Civil Engineering by merely shaping resolutions to inform the world of the seriousness of the problem.

We can further help our cause by providing for a constant exchange of surveying information and literature between our group and high school and college libraries. This medium may serve to whet the student's interest at the formative stage.

Another approach is to provide speakers capable of meeting with student professional groups. These men, when talking about the geodimeter, magnetometer, electronic mensuration, and astronomical equipment surely will enlist some interested men from civil engineering, electrical engineering, physics, and mathematics to enter into the higher level work of surveying and mapping.

These suggestions for solving our problems are not new and are not considered to be the panacea for our immediate ills. However, they are legitimate techniques for attracting competent personnel.

In order to help alleviate the aforementioned deficiency in technical manpower, the Pennsylvania State University now offers a two-year terminal type curriculum which leads to an Associate degree in specialized fields.

To date, the program in Drafting and Design Technology and Electrical Technology has been offered at each of twelve Penn State Centers. That they have been successful is attested to by the success of the 195 graduates of the first class of 420 entering students, and the 215 graduates of the second class of 520 entering students. All these graduates have been absorbed by industry. It is interesting to note that 18 of the above graduates have elected to continue their academic work leading to the baccalaureate degree.

Today, we have 1110 Associate degree students at the Centers as compared to 1231 Baccalaureate degree candidates. In the fall of 1957, we will be offering for the first time a curriculum in Surveying Technology. The objective of the curriculum is to provide a knowledge of the elements of surveying as applied to construction, land, topographic, geodetic, city, and photogrammetric surveys and to develop trained personnel who will understand the relation between the precision of measurements and the interpretation of data, in addition to having an appreciation of the skills and equipment needed to make precise measurements in the field of surveying.

An applicant for admission to the Surveying Technology curriculum must be a graduate of a secondary school and shall have completed 15 Carnegie units of preparatory work. In addition, he must have a minimum of three units of English and two units of mathematics. Many of the students entering the two-year curriculum are eligible for admission to the four-year curriculum, but because of performance and aptitude are advised by qualified counselors to enroll in the Associate degree program rather than the Baccalaureate degree curriculum.

The curriculum outline is in many respects similar to that which is offered at Georgia Tech and similar to the outline described by Mr. W. B. Williams. We have provided instruction in both the oral and written form of communication as evidenced by the inclusion of English Grammar, Composition and Rhetoric, Report Writing, and Effective Speech courses. The humanities are covered solely in the courses on Government and Politics in Modern Society and Psychology in Industrial Relations. This deficiency is common in all two-year curricula where the main objective is to prepare the graduate in a minimum amount of time for immediate assignment to specific categories of work. The mathematics sequence is not as strong as desired, as the circumstances which prevail at the Centers prevent any other treatment at this time. In order to unite the classroom work with the practical aspects of surveying, we have included a four-week summer surveying camp. Here the students will be confronted with problems usually met in the profession.

We are very optimistic regarding the demand for such a course and the quality of students who will elect to try this program, and I hope that in two years I can report favorably on our experiment.

Is a Two-Year Junior College Course Likely to Produce More Registered Land Surveyors?

By W. B. WILLIAMS

I WISH to make only two points: (1) Land surveying is not, and never was, a phase of civil engineering, and (2) To become a competent land surveyor, a postulant must first serve a period of time as a survey-party chief on land surveys.

Because many of us are registered in both professions—from the financial viewpoint this is very practical—and because the field party laying out a highway, sewer, or water system, uses the same equipment as that used by a field party staking out a lot or any other legal description of land, it is presumed by the uninitiated that each can do the other's work. Up to a certain point and if consideration is given only to the field work, they can. But when the lot survey becomes a little complicated by a surplus or shortage in the block or when the highway survey requires slope staking or superelevation of curves they can't.

Such being the case, why try to teach land surveying as a part of a civil engineering course? As was repeatedly stated by last year's panel on practically this same subject and has many times been stated previously, the civil engineering course is so steadily overcrowded with new subjects that it is virtually impossible to crowd them all into a four-year curriculum. When I was an undergraduate forty years ago, we had required courses in pattern making, machine shop, forge, and foundry. These are now all deleted from the civil engineering required list at my alma mater, the surveying and drafting courses have been materially reduced, and undoubtedly will be still further reduced as new subjects become essential to properly introduce a student to the broad field of civil engineering.

Neither, in my opinion, is it any more essential for the land surveyor to know the theories of the transverse Mercator projection, geomagnetism, hydrometric analysis, or the details of photogrammetric map preparation than it is to know thermodynamics, the theory of hysteresis in electrical currents, or the most recent concept of the components of the atom. If this be heresy, pray make the most of it. I do not in any way wish to infer that the subjects first named are not essential to surveying in the broader sense, but these are advanced studies that can, I believe, best be pursued in postgraduate courses.

An academic course for a land surveyor does not require advanced mathematics. Plane trigonometry, or at the most analytic geometry, is sufficient, but it must include extensive computation and mapping courses. It must include the law of real property, business law, general survey law, and in many States plat law. This will be somewhat difficult as these are all State laws and vary somewhat from State to State, but this is true of all law courses. It must also include the history and methods of procedure of the General Land Office survey, land use and town planning, and, last but not least, English, letter writing, speech, and technical reporting. It is my opinion that this can be accomplished in two years of academic work, particularly if field experience is obtained either at a summer camp or by working for an intermediate year in the office of a practicing surveyor. I have prepared a suggested curriculum for such a course and there are a few copies available on the table. It would appear that it could well be given at a junior college rather than a senior college, thereby alleviating the load that is now being placed on these institutions, and also reducing the cost to the student.

Granted, this program may not comply with the better theories of education, but where does education stop? Is there magic in the number "4" that indicates that anyone with less than four years of college is uneducated? If so, some of our prominent attorneys are in this category, because it was not too many years ago that a law de-

gree could be obtained after three years in college, and the same was true in medicine. Incidentally, if I may be personal, I only attended college three and two-third years, so I too am uneducated by this criterion.

But, even assuming that a young man who takes such a course is not fully educated by academic standards, is not half a loaf better than none? Land surveyors always have been and always will be needed in organized communities. For ten years we have bewailed the fact that no senior college offers a course in land surveying. Why should we hesitate to follow in the footsteps of the doctors and lawyers and start with a rudimentary course—in a junior college, if necessary.

NOTE: Since this paper was delivered, the Grand Rapids Junior College has decided to offer a similar course in the 1957–1958 catalog.

Is This a Problem of Recruitment for the Surveying Profession?

By SUMNER D. IRISH

THE PROBLEM of recruitment of technical personnel has hit us in this country hard and square in the last few years in almost all phases of our technical work. In some branches the shortage has been slower to develop to critical proportions than in others. The need for an aggressive recruitment policy as far as the land surveyor is concerned is now being felt, and is attested to by the existence of this panel.

So that no misconceptions may develop, let me first say that I am considering the recruitment problem from the standpoint of the colleges only. There are others who are far more capable than I to talk about the many other facets of this problem. Also, let us pinpoint the factors which must be considered in this problem. They revolve around (1) the number of people involved in this question, (2) the pay scale that must be considered, and (3) the specialized training expected in the recruits.

Land surveying is a fairly basic consideration, of which all communities should be cognizant—I think we can all agree to that. As a rough estimate of the number of men involved in this profession, let us say that there should be one licensed land surveyor for every 10,000 people. If we were doing the job we would like to do, I think this is a conservative figure. The population of the United States is now slightly in excess of 170,000,000. By simple division, we arrive at the figure of 17,000 good, qualified land surveyors in this country.

Assume if we may that we are talking about the normal, college graduate going into the profession. He will be 22 years of age when he starts to work. Assume again that he will retire at age 65 and enjoy the fruits of his years of labor. From this we can see that he will have 43 years of employment in the profession. Taking the figures of 17,000 surveyors in the entire nation, and an average working span of 43 years, it means that 395 new surveyors must come into the field each year. This is the size of the group we are talking about.

Now look at the number of civil engineering graduates with the bachelor's degree which are turned out each year. The average for the past five years, 1951 to 1955, inclusive, was 4,516 men from the 136 accredited colleges in the United States.

If the land surveying profession is to be made up of college graduates, it will then have to secure nearly 9 percent of all the graduates that are available, or, on the average, 3 graduates from every accredited school every year. And this does not take into account attrition from natural causes, which makes the average working span less than the 43 years considered above. Nor does this include the graduates who are needed in geodetic and topographic surveying with the government or private concerns.

In regard to salary, the present average starting salary for engineering graduates is $435.00 per month, and going up. Whether we like it or not, the graduates who are out job hunting are very heavily influenced by that starting figure.

The claim is often made that the fresh graduate is not worth that much money to a surveying firm, but that situation is not peculiar to the surveying type of organization. It is true of all types of enterprises which the new graduates enter. It is now just one of the facts of life that if a new graduate is to be hired he must be paid approximately $435 per month, or $5,220 per year.

It is also well to point out that many corporations, both large and small, as well as many government agencies are now using trained personnel men to recruit these graduates. These recruiters invariably know the pattern of approach and the "give and take" which must be used to influence these fresh graduates-to-be. A lone surveyor trying to recruit another man for his organization is bucking up against some stiff competition when he presents his sales talk.

The third point I want to discuss is the training of these college graduates. As all of you know the time devoted to surveying in the typical civil engineering curriculum has been cut down and cut down. One good solid course in pure surveying is all that a great many of our students receive. In this "squeezing-down" of the surveying, that portion devoted to land surveying has probably been as badly squeezed as any portion. As a result, I consider the contact which I can permit my students to have with land surveying to be no more than a warning not to embark upon it without further study and preparation. Because of this situation, the civil engineering graduate is not truly qualified to enter into professional land surveying work when he graduates. He should serve an apprenticeship of several years before he can consider himself qualified. Land surveying properly taught requires a knowledge of certain legal concepts which the present civil engineering graduates, under the continually increasing pressure to learn more about the latest things in engineering, will never have an opportunity to study adequately.

What, then, does the civil engineering graduate have to offer the land surveying profession that is peculiar and distinctive? It is very little. Because of his training, he will presumably absorb the necessary knowledge faster than a non-college man and be able to contribute usefully to the organization sooner. But this also could be said of him if he went to work for a bakery, a hardware store or a lumberyard as well. I am afraid he is not any better prepared for the land surveying profession than he is for many other positions seemingly unrelated to civil engineering.

From the above, certain conclusions can be drawn. The *first* is that the civil engineering graduate is not particularly well prepared for the land surveying profession; all be it, he is still somewhat better prepared than other college graduates for this type of work. *Secondly,* he wants and commands a starting salary in excess of that which possibly any land surveying firm is prepared to pay. And *thirdly,* the number of men involved in this matter is so large and recruiting nowadays is so competitive that it is very doubtful if the engineering colleges could supply an adequate number of graduates even if the salaries were inviting.

The recommendation following from the above conclusions which I would make at this time, as a college educator, is that the land surveying profession should face up to the problem at hand and realize that the four-year colleges are not the source of their personnel needs. This must be realized. The land surveyors must face facts. They must determine where they can get the men they need, in adequate numbers and at the price they can or are willing to pay, and then go out and exploit that market.

The Fair Labor Standards Act and Its Application to the Civil Engineering and Land Surveying Profession

The following is a condensed version of the discussion, "Interpretation of Fair Labor Standards," which was a part of the program at the meeting of the Property Surveys Division, held during the morning of March 8, 1957, as a part of the Seventeenth Annual Meeting of the American Congress on Surveying and Mapping. The principal speaker was Mr. Joseph Goldberg, Chief, Administrative Policy Branch, Wage and Hour and Public Contracts Division, U. S. Department of Labor. Mr. Gordon E. Ainsworth, Chairman, Property Surveys Division, ACSM, presided. —EDITOR

MR. AINSWORTH: I would like to take up the next portion of our annual business meeting, which has to do with representatives from the Wage and Hour Division of the U. S. Department of Labor.

On my left is Mr. Goldberg, who is Chief of the Administrative Policy Branch of the United States Department of Labor. He is Adviser to the Administrator on coverage of law, on overtime compensation, on determining working time, and other matters.

At Mr. Goldberg's left is Mr. William Hoffman, Chief of the Regulations Branch of the Division, in charge of developing wage and hour regulations, including those for exemption—and professional employees.

Mr. Goldberg gained familiarity with the problems of employers under the law through his association with the Division during the past fifteen years. Mr. Hoffman has been with the Division since 1940 in a variety of capacities. Mr. Goldberg participated in the preparation of many of the bulletins which are being distributed today.

Mr. Hoffman is here primarily to answer any questions you may have regarding exemption of professional employees.

To my right is Miss Tuney, who has accompanied them as an observer. Mr. Goldberg.

MR. GOLDBERG: I am very glad to be here, and I hope you are too. I know that you have a very busy schedule. But Mr. Ainsworth was right in setting aside a portion of the time to discuss this very important question of Wage & Hour Law. It is a sound, dollar-and-cents proposition for every employer to know what the law requires.

Many employers have found themselves in the position of having to pay back wages that they did not expect; and in many of those situations it was due principally to a lack of knowledge of what the laws required, rather than from an intent to evade.

The Fair Labor Standards Act has been in existence for nineteen years now, and one would expect that everybody would be familiar with its general provisions. But unfortunately we find that many employers who are busy carrying on their business activities, meeting payrolls and the other problems—of which you all are aware—do not find time to look into these matters and to prevent these unexpected liabilities and the difficulties they run into.

Now, it is not my purpose here today to give you a speech. I have none prepared. I am merely going to sketch in for you the broad outlines of the law itself. We will devote most of our time to discussing the matters which are mostly on your minds, problems which you may be having, questions which you may wish to have answered, and with which you are seeking somebody who can help. We hope we can do that.

The Federal Wage and Hour Law is officially known as the Fair Labor Standards Act. It establishes a minimum wage of $1.00 an hour and requires time-and-one-half for overtime. It also sets up certain standards for child labor. It establishes a minimum age for employment of sixteen years. In hazardous occupations, the age is eighteen years. Another thing that the law requires is the maintenance of accurate records. Those are the fundamental things the law requires.

Now, if you do pay wages above the minimum, and you pay overtime at time-and-a-half, and if you do not employ child labor—I am sure all of you keep the ordinary business records—then you have no problems. You do not have to be concerned about the fine lines of what is covered, what goes into the rate of pay, who is exempt, or who is not exempt. It is of no concern to you at all.

But we know that all of you do have the problems of marginal employees, and you have the problems of making bids in competition with other employers. You have to figure your labor costs, and you have to figure them on the same basis as your competitor. In order to do that you must know when you have to pay the minimum, when you have to pay overtime, and when you do not.

Now who is covered? If the employee is not covered, you have no obligation to pay him in accordance with statutory provisions. This is a Federal law, and coverage is based on interstate commerce. If something is purely local, and has nothing to do with interstate commerce, it is not covered. The law sets out two broad areas of coverage—employees who engage in production of goods for interstate commerce, and employees who engage in interstate commerce itself.

Production of goods, typically, means things that are made for shipping outside the State. But the term "goods" is defined in the law and includes articles of commerce of any character. It would include plans, designs, plats, and reports which are prepared and sent across State lines.

Any employees engaged in preparing those plans and gathering the information that goes into them are considered engaged in the production of "goods" for interstate commerce if the plans will be sent out of the State or if you know, at the time the work is being performed, that either you or your client will send them outside of the State.

Now, in engaging in commerce we usually think of the people who work in the railroad industry, telephone industry, at airports, and things of that sort. But it also includes people who regularly use the mails, the telephone, or telegraph for interstate commerce. If you have a substantial amount of interstate business correspondence regularly, and your clerical employees are engaged in getting that correspondence together, that constitutes "engaging in interstate commerce." So you must keep that in mind.

The important area of coverage with respect to the industries where you people are engaged is construction. You are closely allied with the construction industries in the sense that you do the preliminary planning, you do the designing, and you are the ones who lay the basic groundwork for the construction activity. In determining whether a job of surveying, mapping, or planning is covered, the inquirer should know whether the construction job that will be following your activity is covered.

In the field of construction, based on the decisions of the courts, coverage will include any repair, maintenance, replacement, enlargement, construction, reconstruction, extension, or improvement—that is a lot of words, and these are the *key* words—of any existing production facilities for interstate commerce, or any instrumentality of interstate commerce.

In other words, what we must look for is the *purpose* of the particular construction activity. If it is to be a television station, an airport, or a highway it is going to be covered. If it is to be an extension of an interstate water system or water works, or it is to be an improvement, extension, or enlargement of an existing factory for producing goods for interstate commerce, it is going to be covered. If you do not have an instrumentality of interstate commerce, if you do not have a production facility for goods for interstate commerce, you do not have any coverage.

That means that if you have work in connection with local stores, schools, churches, police stations, and all local projects that are carried on within the confines of a State, you are not covered, and the preliminary work related to them is not covered.

The one exception you must keep in mind is in connection with city streets. If they connect with an interstate highway, if they are going to become a part of an interstate

highway—and there may be few that do not fall in that category—they are covered. There is one area of exception. That is the area where a man is projecting a local residential development, and, on the private property, he is going to mark out the streets, he is going to construct the streets, and these residential streets are for use of the particular area. In that case there is no coverage for the construction of those streets. At least we have taken the position that we will not assert coverage in these cases until the courts do hold differently. But, until the courts do hold differently we do not take the position that there is coverage in these private residential developments which are not a part of an interstate highway system.

Now, suppose you have a particular situation—the job is covered, and the employees are covered. The next question that may present itself, and it *must* present itself, is: Are any of my employees exempt from this overtime?

The most significant exemption for you people—as a matter of fact, I believe it is the only one that applies—is the one for so-called white-collar workers, but it does not extend to *all* white-collar workers. It extends to executive, administrative, and professional employees and to outside salesmen who meet the tests which the administrator has set out in regulations. Those regulations are contained in one of the bulletins distributed here today. These regulations speak for themselves. The tests are there. There is also an explanatory bulletin, and it contains explanations of the various criteria.

If you have any difficulty in any particular case, in finding whether a particular employee meets the tests, you should communicate with the nearest office of the Division and get advice. If you get advice and are told that he is exempt, you can rely on that.

I do not propose to go into that aspect here because of the fact that in the bulletin it is very well explained. We have Mr. Hoffman with us, and any questions that may come to your mind he will be very glad to answer.

Coverage is on workweek basis. In other words, an employee may be covered one week and not another. He may be covered in one job and not in another. But if he performs a *covered* job within a workweek he must be paid according to the standards for the whole week. If he performs no covered work in the week, the Act's pay standards will not apply to him that week.

Now this is important in determining how to pay. The minimum wage is a dollar an hour, and you have to pay him that for all the hours he has worked during the week. Working time includes "all the time that the employee is giving to you," in a general, rule-of-thumb way. Particularly, technically, it is defined as "all time during which an employee is required to be on duty, or on the employer's premises, or at a prescribed work place."

If you go out one day and you find that conditions are not suitable for work, and you tell your employees there will be no work today, you do not have to pay them from the day you excused them. That may also be true in cases where you have worked half a day, of course, and you terminate your employment at that point. It may also be true, of course, when you start in the morning and you find there are a number of hours during the day when you cannot work, and you tell the employee he can go off the job and come back at, say, two o'clock. You do not have to pay the employee for the intervening period, if the period is long enough that he can use it effectively for his own purposes.

If, however, you are away on location, and you tell him he may have the next hour off, you cannot very well exclude that hour if he cannot use it for anything. He is there to perform your work and, during the period that he is there, you have to pay him.

Neither do you have to pay employees for holidays, vacations, and sick leave. In many cases there is a practice of paying them for it. However, when you are paying them for it, you do not have to count the time as working time under the Act.

The next problem arises if the employee works more than forty hours a week. Under the Fair Labor Standards Act, there is no *daily* overtime requirement. There is another law—and I am not going to speak

about it right here—that has to do with that. The Fair Labor Standards Act does *not* have a *daily* overtime requirement. It does not require premium payments for Sunday, or holiday work. Only if you work over forty hours in a week, is overtime required.

The rules for computing overtime are not difficult unless you have a very complicated rate structure. Overtime may be hard to pay but it is very easy to compute. Of course, what the law requires is that you pay time-and-a-half at the regular rate of pay. The regular rate means the actual rate which the employee received for the work he performs. It includes all remuneration for employment. The law excludes certain kinds of payments. It excludes holiday and vacation pay, expenses, and sick leave, and certain other payments such as those. But all other payments—production bonuses, ordinary premiums, shift differentials, premium payments for hazardous work or for undesirable work—all of those payments must go into the regular rate. It is a simple mathematical problem to add up the pay he has received and divide that by the hours he has worked during the week to get the regular rate.

If he is on an hourly rate basis, and receives no other pay, you simply use that hourly rate and pay 150 per cent of that for overtime. If he is on a salary basis, you convert to an hourly rate and then compute it. Here, too, the workweek is the standard. The overtime is computed on each workweek standing alone.

You cannot average the hours over two weeks. Say he works 42 hours in one week; he is entitled to two hours overtime pay for that week, regardless of the number of hours he works the other week.

Now, on record keeping, which is the only other requirement; again there is no serious problem. The records must show hours worked each day and each week, the rate of pay, and the pay an employee receives; in addition to certain general records such as the name of the employee, his address, etc., which every businessman keeps in any event. These records are not required to be in any special form; records of the type which almost every prudent businessman keeps are sufficient.

These are the general outlines of the law.

I mentioned a moment ago that there are certain other laws that may affect you. I am not an authority on those laws, but I do want to mention to you that there is the Davis-Bacon Act which applies to construction where Federal funds are involved. The Davis-Bacon Act does not have any overtime provision. That law requires the payment of wages at the prevailing rates, and those rates are set by the Secretary of Labor. If you ever get on a job where the Davis-Bacon rates are required, they are specifically required in the contract or determinable at the particular time for the particular job.

There is also the eight-hour law that applies to Federal public works and to certain contracts to which the U. S. Government is a party. This law applies only to laborers and mechanics. That law sets a limit of work for laborers and mechanics of eight hours a day, and requires time-and-a-half for over eight hours.

That is the general picture. If there are any questions I will be glad to answer them. A question has come up about the Walsh-Healy Public Contracts Act. That is a law that applies to contracts with the Federal Government for the manufacture or supply of articles and materials where the contract amount exceeds ten thousand dollars. There, again, I am not an authority on the subject, but the Public Contracts Act would not apply if the contract is exclusively for personal service. That is a question Mr. Ainsworth has asked, and I am not sure of the answer. If you have a government contract which calls for furnishing articles such as maps, plats, etc., you should inquire of the Labor Department whether the Public Contracts Act applies in your case. Thank you.

MR. AINSWORTH: Mr. Goldberg and Mr. Hoffman would welcome questions from the audience.

MR. MCSWAIN (of Georgia): I gave my name, sir, because yours is the only agency that hasn't got me yet. (Laughter.) I have only one question, and I will try to be brief. Within the last eight or ten years or more,

I have had a dozen or more subdivisions in a county, the street layout of which was approved by the County or City Engineer. They are strictly county or city streets. I do know now that there will be six or eight of them; we are going to have an interstate highway breaking through them. Am I safe from any retroactive action? I have always paid the minimum, I think, but some of these days will I have some action slapped on me for the interstate highways?

MR. GOLDBERG: I am not going to attempt to say just what your situation will be, because I am not an investigator, and we are not going to send investigators down as a result of your conversation. When you are building any kind of a road which will connect directly with a highway, it is a covered construction project.

Now the only exception, as I mentioned before, is where you are building roads in a private subdivision for the purpose of providing access to the subdivision and access to the individual dwellings within the subdivision.

There may be a commercial development in there too. In other words, you may have stores in there. But if it is on private property, picture it as an island. On private property, wherein streets are laid out for the convenience of a community, that is not covered, merely because a little access road goes out to meet the street which eventually meets up with the road.

But the Supreme Court, in a case that we had recently, has indicated that in considering construction work on instrumentalities of interstate commerce, you cannot view the project in isolation. You have to view it in terms of the network within which this forms an essential link. Thus, if you are constructing a roadway that is going to connect to, and it is going to become a link in, the interstate chain of communications, even though it does not directly connect up with the main road itself, it is a covered operation.

MR. MCSWAIN: Suppose I did not know that the project was covered; would I nevertheless be liable?

MR. GOLDBERG: Mr. Ainsworth asked that question. He has become quite an expert on Wage & Hour. He presented that question in a similar form in a discussion we had. We had a lawyer present, and he said, "Ignorance of the law is no excuse." That is why I mentioned at the outset that it is important to know the rules. In other words, the mere fact that you did something because you assumed it was not covered, does not excuse you from paying the minimum wage.

A VOICE: Suppose it is not covered now but is covered later. What about that?

MR. GOLDBERG: The coverage is written, it is in the Act. Unless Congress modifies it those are the limits of coverage. So that it is not a situation in which someone comes out and says, "This is covered now but it was not covered yesterday." In other words, the law having been written, the limits of coverage have been set. A thing is covered or not covered on the basis of the language in the law.

MR. HAMILTON: In the event a subdivision lies between two farm-to-market roads, approved, and it is a known fact that this will be a shorter route between the two roads, would your interpretation be that the construction and subdivision on both sides would be a covered project?

MR. GOLDBERG: Subdivision?

MR. HAMILTON: Yes, sir.

MR. GOLDBERG: No sir, the subdivisions are never covered.

MR. HAMILTON: No sir, I mean the actual layout of the property, the layout of the road.

MR. GOLDBERG: The only problem would relate to the layout of the road itself. If the road is a farm-to-market road, and it connects up at the other end with any interstate highway, it will be covered. You will look at it as a network chain, as if it were the arteries of the national commerce. Any time you build a road that extends to those highways it becomes an essential part of the interstate network of roads.

A VOICE: I have two questions. First, may the employer determine the workweek as Monday to Monday, or Wednesday to Wednesday; and, secondly, what do you pay

time-and-a-half on? Must you break down to an arbitrary rate, or can you use a daily rate, or weekly rate?

MR. GOLDBERG: The employer can determine the workweek. The workweek is a fixed period of seven consecutive 24-hour days. Ordinarily you can determine a workweek for each new project, assuming that it is a new activity. But if you have a workweek for your establishment it must be intended to be permanent. That does not mean that you cannot change it. When you change it, the intention again must be an intention to make it permanent.

When you have a change-over of workweek, we have an overlapping period; if there is any work done during the overlapping period, compute the old workweek and the new workweek, including the overlapping period each time, and you pay the employee whichever gives him the most compensation.

Now the second question you asked is whether you have to break down the rate to an hourly rate. The regular rate on which overtime is computed under the Act is an hourly rate. Overtime is always computed at an hourly rate. Now, where you have a salary that is paid for a period of a workweek, you simply divide the salary by the hours which you intended to pay, and you get your hourly rate in that fashion. If you have a semimonthly salary, you multiply your semimonthly salary by 24, divide by 52 to get your weekly equivalent, again divide by the number of hours for which the salary is intended to be compensation, and you get your hourly rate.

MR. KELSEY: There was one point. In our industry we do not have close control of knowing how many hours our employees work. There are two or three systems.

Around Cleveland, construction firms pay their help from the time they get on the job until they quit. In other words, they work eight hours at the job.

Most of the surveyors pay a nominal eight hours a day. The fellows are supposed to work as close to it as they can. They leave our office at eight. Some of them have travel time back on their own time. They put in six or seven hours actual worktime.

I pay flat salaries. I have employees who work on a forty-hour basis and others who work on a forty-eight-hour basis. They get a flat salary a week, whether they work or not, that is, so much a week. There is that overlap. Some days they might be fifteen minutes over. I have no way of checking it. They themselves would not know. We do not keep track of that little over-and-under part of the day. You cannot stop them all just because it is four o'clock, and you cannot anticipate the traffic jams in a town the size of Cleveland nor how long it will take to get back.

MR. GOLDBERG: Well, the problem of maintaining a regular salary is a very important one, particularly in your industry and in your profession, and we recognize that. There are many ways of maintaining or of attempting to maintain a regular salary. Some of them are very complex. Some of them are at the present time in very serious dispute. I think it is a question that concerns a lot of people, and I think it will be worthwhile taking a few more minutes in answering your question.

You can pay an employee a flat salary for all the hours he works in a week. In other words, you can arrange with your employee to pay him a stated salary, say $80.00 whether he works 40, 45, 50, or 60 hours a week. You can do that under the law, but only as straight-time compensation.

If he works overtime in any week, that is, over forty hours, you will have to pay him extra half-time only in addition to the salary for each of the overtime hours. The method of computing that is the same as previously explained. In the case of the $80.00 man; supposing he worked fifty hours in a particular week, you divide the fifty into the eighty, you get a rate of $1.60, and he would get $0.80 additional for each of the ten hours, or $8.00 overtime in addition to his $80.00 salary.

That would meet the requirements of the law. If he does not work overtime you still pay him the eighty dollars. That is the "fluctuating method of compensation," so-called. In the weeks when he works forty-five hours, you divide the $80.00 by forty-five. Pay him the extra half-time at that

rate for the five hours, and you have met your overtime.

A VOICE: Will you elaborate on the telephone question.

MR. GOLDBERG: Yes. When you have a job out of the State, you are going to have some other employees, perhaps not your field workers, who may be covered because they regularly use the telephone or the mails for interstate communication. It may be that your surveying employees will be covered also, if they make reports, if they prepare the materials that go into the reports that will be regularly sent across State lines. On this "regularity" question I do want to elaborate.

That law does not consider that you are covered merely because on occasion you send something outside the State. You have coverage only if your engagement in interstate commerce is regular and not merely occasional or sporadic.

The mere fact that your office employees may occasionally mail your income tax returns or some other kinds of papers outside of the State, will not cover them. But if they regularly use the telephone and the mails for interstate communications, then they are covered in any week in which they are engaged in such work.

MR. BAUER: My name is Bauer. Cleveland, Ohio.

I want to ask a question about figuring the "workday." The number of hours in productive work, where the survey party, let us say, puts in seven hours of actual work in the field, but they might have three hours of traveling time back and forth to the job.

MR. GOLDBERG: Travel from home to work and back again at the end of the day is not working time under the Act. So that, in the ordinary case, home-to-work travel time may be excluded from working time. But you may have different situations. You may have a situation where a man drives a truck with equipment. The driving of the truck with the equipment is working time. However, employees who ride with him are not working, unless they are riding there for the purpose of helping him drive the truck.

There is another aspect which I want to mention. The bulletin does recognize that there are minor discrepancies in the maintenance of hours worked. That is the "Hours Worked" bulletin. The Divisions will accept computation of working time to the nearest quarter of an hour, provided of course it is operated in such a way that it will even out over the long stretch. If you have a regular starting time at a certain period and then the employee appears a little earlier, and some days appears later, and you disregard that in each case, the regular starting time will be accurate for the purposes of the law.

A VOICE: In case we have questions or interpretations of the Act and provisions of coverage may we contact your office without prejudice or hazard?

MR. GOLDBERG: Yes. That has been one of our cardinal principles. We have been very circumspect on that. Any time you write us a letter, we answer that letter on its face. We do not refer that letter to our investigation division. It is a cardinal rule with us. It has never happened. If you are investigated, it is either because somebody filed a complaint about you or because in the ordinary course your firm has been scheduled for investigation. It will not be the result of a contact you make with either our national office or with any of our local offices. They are there principally to help you, and we take that all very seriously.

RICHARD MAWHINNEY: Sir, I wish to ask a question as to coverage of employees who may be engaged in making a timber survey of pulpwood lands. The timber eventually will find itself in the form of paper products in interstate commerce. But it seems a little bit remote from the immediate survey.

MR. GOLDBERG: Those employees will be covered, and it is true that there is a remoteness in time. But there is a direct relationship in connection with the work performed. You will have that in a variety of situations where the initial step may be a long way removed from the eventual construction or the eventual product that finds its way in interstate commerce.

You have a situation where you are surveying land for road construction, and there is no assurance, even at that particular time, that a road will be approved. But

nonetheless, it is essential step in the construction of that road, and whether it is approved or is not approved, or even if it is abandoned, coverage exists as of the time that the work is performed. If at the time when you perform the work you know or have reasonable cause to believe that the goods will eventually go out in interstate commerce, or that the instrumentality of interstate commerce will be built, then you are covered.

You have the opposite side of that too. Supposing you are surveying land for the purpose of constructing a local plant, and that is your knowledge and that is the best reason that you have to believe the purpose of this particular job. Later, it turns out that they are going to construct a television station there. If, in fact, as a reasonable man, you had no basis for believing that this would be a covered facility, the work is not covered even if eventually it turns out they change their minds and build a television station.

A VOICE: Will the land surveys surrounding a farm which obviously will grow products which will go in interstate commerce—any farm survey, in fact—constitute interstate commerce?

MR. GOLDBERG: I asked for the advice of Mr. Hoffman, who is an agricultural expert. Ordinarily, what you say is correct, that any survey of a farm that produces farm products for shipment in interstate commerce will be a covered survey. Now it may be in some cases that the work is performed entirely on a farm, and if the employee works an entire week on a farm—it doesn't have to be for a single farmer—

MR. HOFFMAN: No.

MR. GOLDBERG:—then there is an exemption for agriculture. You may find yourself eventually to be in that category, but I think that is a remote possibility.

MR. HAMILTON: My office does a considerable amount of what we term "closing surveys," done for lending institutions, both local and out-of-state. The title insurance companies which basically request such surveys are out-of-state companies. Is the time spent on those surveys and drawing the plat a covered occupation? Perfectly frankly, a copy of that survey does go out of the State. The survey is of a private residence.

MR. GOLDBERG: Well, that is a very close question. The surveying of private residences in and of itself is not covered. Coverage can occur only because of the fact that you are producing reports and plats, that are going to be sent outside the State. The Divisions have taken the position that plats, reports, and surveys are goods, and if they are produced for shipment outside of the State there is coverage. It is a question that is not entirely free of some doubt. But that is the Divisions' position, and I believe that that is the way we would construe it in any place we were to find it.

MR. GHENT: Sir, I am not quite clear, going back to this travel time. If we have employees who are required to report to our office normally and there they are loaded into the truck and are sent out onto a specific job, and then in the evening they normally come back to the office, as I understand it their work would begin at the time they are required to report to the office and would end at the time they report back to the office.

MR. GOLDBERG: Not necessarily. There it depends on whether the employee is reporting to the office for the purpose of receiving instructions. Or whether he is reporting merely to get out to the site.

MR. GHENT: He is reporting merely to get out to the site.

MR. GOLDBERG: If he is reporting solely for the purpose of going out to the site, is not reporting for instructions or to pick up tools, is not reporting to drive a truck or to do any other work, and he does no work on the premises, then the time of travel to the work site and the time of travel from the work site back falls in the category of home-to-work travel and is not working time. Does that answer it?

A VOICE: To make sure I understand exactly—I believe I understood you to say that if you paid a man by the month you could require him to work, for instance, sixty hours a week and pay him $300.00 a month, and then that was O.K. I am thinking of the case of the rodman or chain-

man who reports to work at seven-thirty and gets back in at five-thirty at night, and who is on a monthly salary. He is told those will be his hours six days a week and he is, say, paid $300.00 a month. Are we complying or not.

MR. GOLDBERG: Well, of course, if you do not pay him any extra for overtime you are not complying. For sixty hours a week he is entitled to twenty hours overtime pay. If he consistently works sixty hours a week, that is his fixed workweek and you have made it clear to him that the salary includes —let us take for example—payment at the rate of a dollar an hour for the first forty hours and time-and-a-half for the twenty hours; in that case it would be a total of $70.00. If the understanding between you and him is that he works a fixed schedule and he does in fact work a fixed schedule, then the payment of $70.00 a week will be in compliance. The weekly salary may also be converted into a monthly sum, by multiplying the weekly salary by 52 and dividing by 12; or to a semi-monthly salary, by multiplying by 52 and dividing by 24. Payment in such manner will satisfy the requirements of the Act.

But you must keep in mind that your agreement with him, is in fact, payment at an hourly rate, and that if he works more he gets more, and if he works less he gets less, based on actual computation of the hours worked at the rate that you agreed upon with him. You cannot disregard the hours he works. Paying him the $70.00 regardless of the number of hours worked is not complying with the law. It is only if he works a fixed number of hours that he is entitled to that pay, and then he gets that pay, but, in that case, as I previously mentioned, you need make no deductions for holidays, absences due to sickness, occasional absences such as attending a ball-game once in a while, or similar absences. But if he does not work sixty hours regularly, then that method of payment is not proper.

MR. AINSWORTH: I am sure that we could all stay here the rest of the day and discuss this. We are getting a lot of very valuable information. But time has been passing. These people want to go to their lunch. We have to conclude in the next ten minutes the activities of this Division. So I am afraid that we will have to end the very interesting and important discussion of the Wage & Hour Law.

We thank these people very much for their being here today, and we will collaborate with them in the preparation of the material that is being assembled here by means of the transcripts. Thank you very much.

New Courses in Geodesy

The following is reprinted from the November 15, 1957, issue of United States Department of Agriculture Graduate School *Newsletter* as being of possible interest to a considerable number of readers of SURVEYING AND MAPPING, especially those in the Washington metropolitan area.

—EDITOR

While Sputnik No. I was still beep-beeping around the earth, we started plans for a program of study of special interest to one group of Federal employees who can use the information from artificial satellites in their work—the geodesists and those who plan to enter that field.

Geodesy is the branch of applied mathematics which determines by observation and measurement the size and shape of the earth and precise location of points on it for the control of topographic surveys. It goes back to ancient times but recent advances in theoretical physics and new developments in aviation, rocketry, photography, and electronics have added enormously to its scope and precision.

Paul D. Thomas of the Coast and Geodetic Survey, who outlined the program, points out that a number of new techniques have been developed for ultimately obtaining a new determination of the figure of the earth. The use of artificial satellites for geodetic purposes is only one of the innovations that will be covered in the program.

Our plans call for a two-semester course in the theory of geodesy, a two-semester course in applied geodesy, and a one-semester course in special mathematical problems in the field.

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Use of the Recording Densitometer in Measuring Density from Dot Maps

By WILLIAM G. BYRON

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CERTAIN ASPECTS of the science of photometry (that part of physics which deals with the measurement of light) are of significance in cartography. The technique here described applies photometric tools to the analysis of dot maps, converting the dots on a map into line graphs of density. Using a densitometer, the ratio of the number of dots per unit of area, i.e., density, is measured without reference to either political boundaries or arbitrary statistical areas.

The conversion process is wholly mechanical. Each dot in its spatial environment has a specific influence on the light which strikes it and that influence, small though it might be, can be precisely measured with sensitive photometric instruments. The technique eliminates much of the subjectivity of visual response to complex dot patterns by substituting a sensitive photoelectric cell, or its equivalent, for the human eye.

THE PHYSICAL MEASUREMENT OF DENSITY

The key to evaluating the density of dot patterns by photometric means lies in the determination of the effect that the dots have on the intensity of a beam of light of a known incident value. The dots lose their individuality within each small area that is scanned by the light because, in effect, they are instrumentally diluted and spread out over the entire illuminated area. The arrangement of dots viewed by the scanning beam has no influence on the measurement. The only consideration is the ability of the dots to intercept light if they are black, or to transmit or reflect it if they are white. Knowing the absorption, transmission, or reflection value of an area on the map that has no dots, a ratio may be determined between that area as a constant and all other places on the map where dots appear. This is the concept which forms the basis for the physical measurement of density.

There are three different approaches to the measurement of the ratio of black to white, each of which has a specific definition. These are: (1) opacity, (2) transmission, and (3) density. *Opacity* is defined as the ratio of the incident light I_o to the emergent beam I, or I_o/I; *transmission* is the reciprocal of this relationship, or I/I_o; and *density* is the logarithmic value of opacity.[1] The three values are compared in the following table:

THE RELATIONSHIPS OF TRANSMISSION, OPACITY, AND DENSITY

Transmission $T = I/I_o$	*Opacity* $O = I_o/I = I/T$	*Density* $D = \log_{10}$
1.00	1.00	0.00
.90	1.11	0.045
.80	1.25	0.10
.70	1.43	0.16
.60	1.67	0.22
.50	2.00	0.30
.40	2.50	0.40
.30	3.34	0.52
.20	5.00	0.70
.10	10.00	1.00
.01	100.00	2.00
.001	1000.00	3.00

The distinction between density and opacity is mostly one of mathematical convenience, but it is important that the two terms not be confused. The common concept of density held by cartographers, e.g., the number of people per square mile, would here

[1] This definition, now well established in photometry, was first developed by Hurter and Driffield late in the 19th century. *See* Hurter, F. and Driffield, V. C. "Photo-chemical Investigations and a New Method of Determination of the Sensitiveness of Photographic Plates." *Journal of the Society of Chemical Industry*, 9 (1890): 455.

be comparable to opacity. Density in photometry, using the logarithmic approach, leads to a special definition, the basic purpose of which is to capture the absorption factor in photographic films and plates. Absorption is of little consequence to cartographers. However, the logarithmic technique, which reduces the exponential nature of opacity to a linear function, is a decided asset for at least two important reasons: first, it is in keeping with the principle that visual perception is approximately a logarithmic function of stimuli;[2] and second, a great range of values can be shown on a graph with limited dimensions. Thus, there is good reason to convert opacity to density because density is the better measure of the ability of the eye to comprehend differences of dot concentrations from place to place, and because the full range of values, from empty areas to places of complete coalescence, can be shown on the same graph.

DENSITOMETERS AND DENSITY

There are several kinds of densitometers,[3] each of which is designed to meet a specific requirement of density measurement. Some instruments depend on visual acuity to integrate unknown densities with a calibrated optical wedge, the measurement being achieved when the two samples are brought into a null balance. Others substitute some variety of photoelectric cell or phototube for the human eye and measure densities automatically. The photoelectric type may determine density either by converting the response of the scanning cell to a galvanometer or its equivalent for a direct reading, or they may use the comparison system in which a balance is achieved manually by coordinating the intensities of two beams of light. Where very small areas are to be considered, there are special purpose instruments called "microphotometers" or "microdensitometers" to fulfill this need.

All of these instruments can be applied to the analysis of dot patterns, but some are more cumbersome to use than others. The photoelectric cell type, with its ability to respond automatically and rapidly to changes in densities, is the most practical to use in interpreting dot maps because this type of instrument requires a minimum of manual coordination.

THE ANSCO COLOR DENSITOMETER

In order to investigate the potentialities of interpreting dot maps photometrically, a modified Ansco Model II Color Densitometer was selected for a series of experimental studies. This densitometer, more correctly classified as a microphotometer because it scans through a very small aperture, indicates densities directly and on a uniform scale. Densities from zero to three on the standard density scale can be measured on it with an accuracy of ± 0.02 everywhere within its range. It will record differences in transparency from 100 to 0.10 percent transmission, i.e., from complete transparency to nearly total opacity. It will also measure either transmitted or reflected light, enabling the operator to scan either photographic film or opaque paper.

The heart of the system is a sensitive phototube which equates the ratio of incident light to the emergent, or reflected, beam. The light is concentrated on the specimen area by a series of lenses and filters. The emergent or reflected beam is

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[2] It has long been understood that the eye is incapable of measuring degrees of grayness which are developed on an arithmetical scale. An increase in stimulation by equal steps is not perceived in its true perspective. The Weber-Fechner function, usually stated as $S = k \log R$, in which S equals measured sensory intensity and R equals the measured magnitude of the stimulus, appears to approximate the response of the eye to gradations in density. Psychologists and others have recognized both the importance and the limitations of the concept and have explored the subject from numerous points of view. See for example: Hoagland, H. "The Weber-Fechner Law and the All-or-Nothing Theory," *Journal of General Psychology,* 3 (1930): 351–373; Boring, E. G. *The Physical Dimensions of Consciousness,* N. Y. (1933): 10–13; 60; and Walsh, J. W. T. *Photometry,* London (1953): 53–89.

[3] In this paper "densitometer" is used as the generic term for all instruments that measure the difference between incident and reflected, or transmitted, light intensities. Some authors prefer the term "photometer" for this purpose, reserving "densitometer" for those instruments which calculate the capacities of photographic absorption.

then collected specularly[4] by the phototube, which, according to the manufacturers, will produce a full-scale reading with an illumination as low as one microlumen.[5]

The impulses received at the phototube and its amplification system are translated into density readings by an electronic circuit, making it possible to read density directly from a uniformly calibrated meter. A Brown Recorder can be attached to the instrument where a permanent record of any individual scan is required. In either case, the densities of dot patterns are quickly and precisely revealed. If instrumental calibration or small area analysis is required, the linear meter scale can be used; if the focus is on a relatively large area, the Brown Recorder can be employed to produce a line graph of density along any given traverse.

The Ansco densitometer used for experimentation, modified to meet special spectroscopic demands, almost perfectly fits the needs for dot-map analysis (Fig. 1).[6] The modifications included a special light-source container with a variable slit aperture which was moved, along with the phototube and its amplifier, to a position some distance from the densitometer. A special bed assembly, comparable to a screw lathe, was machined so that the map could be transported at a variable rate of speed under the light[7] By controlling the rate of travel and the dimensions of the scanning area, an operator could systematically measure the densities of dot patterns everywhere on a map.

[4] Specular light includes only the collimated emergent beam. The light that is lost through scattering is not collected for measurement.

[5] *Ansco Color Densitometer Manual of Instructions.* Ansco, Division of General Aniline and Film Corporation, Binghamton, New York, *circa* 1950.

[6] The modifications were planned and constructed by the Syracuse University Department of Physics, under the direction of Professor Nathan Ginsburg.

[7] The cost of the whole assembly, including the densitometer, is estimated to be approximately $1500. Should all the machined parts be purchased commercially, the price would, no doubt, be considerably higher.

CARTOGRAPHIC CONSIDERATIONS AND DENSITOMETRIC MEASUREMENT

With a map at rest under the scanning light, the meter and the Recorder may be calibrated either to count the dots or to measure a ratio, such as the number of people per square mile, or both if the problem so demands. But no two maps are ever drawn and reproduced exactly alike. To the densitometer each new map is a new situation and a new scale is required to eliminate even minor differences in cartographic procedure. Ignoring the instrumental variables until later, some observations can be made regarding cartographic procedures.

Careful attention must be given to the sizes of the dots used because of the controlling influence dot magnitudes have on the total ratio of black to white on the map. If each dot is below the threshold of mechanical resolution, or very near it, it will be lost, because the dot cannot be distinguished from the normal fluctuations of the base line itself. In the experiments conducted, it was determined that the Ansco densitometer could record dots as small as 0.001 inch in diameter. The dots can be made larger if the cartographer so chooses, but then the instrument will not be used to its full potential. At the polar extreme, if the dots are made so large that the symbols fuse together upon reproduction, no differences in density can be measured in the coalesced places.

The final product of the densitometer can be no more accurate than the map that it has scanned; hence the map should be made with considerable care. All dots that represent the same quantitative value must be uniform in size and must be located on a background that is a constant to the collimated beam of incident light. The densitometer is acutely sensitive to even minor differences in dot magnitudes and background environments; if there are any cartographic deviations from place to place on the map the instrument will surely record them.

Some thought also must be given to the medium of map reproduction. Let us assume a case where a map is drawn using black dots against a white or neutral back-

FIGURE 1.

ground. If photographic negatives of the original drawing are scanned by the densitometer, the dots will transmit light; whereas the dots on either film transparencies or film positives will absorb it. The curves on the Recorder will be reversed according to whether the dots reflect or transmit light, i.e., the peaks of curves from the negatives will be troughs from the transparencies; but density readings or dot censuses can be readily extracted and interpreted as long as the medium of reproduction remains a constant.[8]

INSTRUMENTAL VARIATIONS AND AREA GENERALIZATION

There are four instrumental variables and each has an influence on area generalization. They are (1) the slit aperture, (2) the rate of travel, (3) the intensity of the incident light, and (4) the sensitivity of the

[8] In his experiments, the author obtained greater instrumental deflections from film negatives than from transparencies. No tests were made of reflection density, but it is assumed that the deflections from opaque surfaces would be of a still lower order.

FIGURE 2.—The dot patterns from which the traverses shown in Figure 3 were made. For these densitometer traces, the width of the dot pattern was reduced to one-eighth inch. Each dot was then 0.001 inch in diameter.

instrument. Each variable may be independently adjusted on the densitometer and if any is altered, there will be a corresponding change in the physical measurement of density.

Adjustment of the Variable Slits.—When a test sample is scanned, using two different widths of aperture of the scanning beam, everything else being constant, the density curves will not match (Figs. 2 & 3). As the slit is enlarged, each dot takes up proportionately less space in the illuminated area and its effect is necessarily lessened. However, the beam of light will include more dots at any one moment and each dot will be held in the path of the light for a longer period of time. There is thus the opportunity to generalize a density reading mechanically by widening the slit or to particularize it by narrowing it.

Adjustment of the Rate of Travel—The densitometer trace of individual density units can be radically affected by altering the rate of speed that the map travels under the fixed light source. The instrument used for the experiments could be adjusted to scan from ½ mm/minute to 18 mm/minute, and the results near these two limits are portrayed in figure 4. It will be seen that the area generalizations are of a somewhat different order than those afforded by the adjustment of the aperture. The Brown Recorder responds nearly instantaneously to changes in densities so that dot patterns separated by even a relatively narrow interval cannot be linked. If the linear rate of travel is suffciently increased, the density slopes revealed by the Recorder can be steepened to where the horizontal components are essentially lost.

Where the dots patterns are separated from one another by very narrow spaces, the

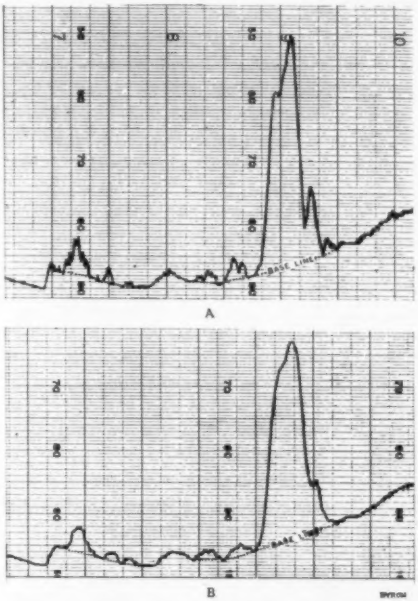


FIGURE 3.—Graphs showing the traces that result when the width of the scanning aperture is altered, everything else being constant. Test case A. Aperture 0.125 by 0.020 inch. Rate of travel 1 millimeter per minute. Test case B. Aperture 0.125 by 0.040 inch. Rate of travel 1 millimeter per minute.

recording pen on the Brown Recorder becomes an associate factor. If the map travels under the light source at a relatively high rate of speed, the spaces will be lost in the coalescence of the ink lines. The result is an apparent linking of the patterns, although the recording pen may have made a separate register of both the patterns and the intervening spaces. (Fig. 4).

Adjustment of the Intensity of the Light —Assuming that the sensitivity of the densitometer remains constant, i.e., there is no change in the density scale, the adjustment of the intensity of the light leads to a migration of the base line on the Recorder. There are times when it is important to take advantage of this characteristic. Occasionally the background density may be so irregular that the base line will drop below the recording capacity of the densitometer. In such a situation the base may be brought back to its original position by increasing the intensity of the scanning light and the readings can proceed as before.

Sensitivity and the Three Density Scales.— The modification of the Ansco densitometer included a provision to change the recording range of the Brown Recorder. Three different levels, corresponding to *0–1, 0–2,* and *0–3* densities can be directly translated from the densitometer to the Recorder, making it possible to generalize areal relationships of the dots by altering the contrast of the dot-background components. Normally, the amplitude of the peaks will decline as the density range increases, i.e., the response to a dot pattern on scale *0–2* will be less than on scale *0–1* provided the illumination remains constant. Should the contrast be adjusted midway in a traverse the true scale relationships must be calibrated separately because the net density balance has been changed.

One implication of considerable promise arises from the fact that the deflections are in part a function of the value of the background. It is possible to control the quantitative measurement of density by taking advantage of the different sensitivity capacities of the three density scales. By altering the ability of the background to interrupt and dissipate the incident light, the dots can be assigned different quantitative values without redrawing the map. Using photographic negatives as an example, the deflections can be controlled by adjusting the contrast of the film.

Such contrast control is also significant when the densitometer is required to measure a great range of densities, where both the individual dots and the peaks of high concentrations cannot be recorded on the same scale. This situation would be very unusual owing to the logarithmic interpretation of black and white that is density; but there is a solution for the special case. If companion traverses are made on two photographic negatives, one of which has a nearly opaque background and the other of which approaches a normal contrast, two different sensitivity scales can be employed. Two negatives may be used if the subject is identical but the contrast is different, or one negative may suffice by bleaching the background for the second traverse. Any part of the peak of the trace that is lost on the first negative will be recorded on the second because two different density ranges have been used. This naturally requires a separate calibration check for the second negative in order that the density record may be truly interpreted.

FIGURE 4.—(Opposite page) Graphs illustrating the effect of a change in the rate of travel.

A. The basic patterns submitted for densitometer analysis.

B. The patterns reduced to the scale used in the analysis.

C. Densitometer trace of the square. Rate of travel 1 millimeter per minute.

D. Densitometer trace of the rectangle. Rate of travel 1 millimeter per minute.

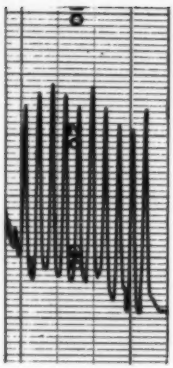
E. Densitometer trace of the offset squares. Rate of travel 1 millimeter per minute. The trace indicates that the aperture was not uniformly illuminated.

F. Densitometer trace of the dot star. Rate of travel 1 millimeter per minute. The trace indicates that the aperture was not uniformly illuminated.

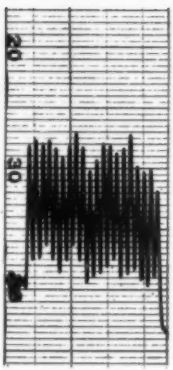
G. to J., inc. Densitometer traces of the four basic patterns. Rate of travel 18 millimeters per minute.

A

B



C



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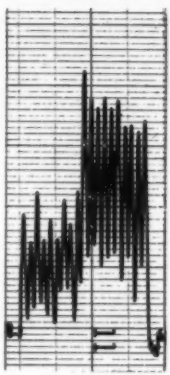
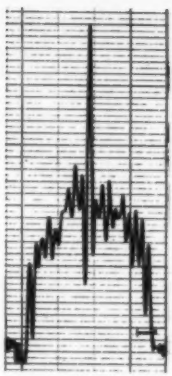


E



F

G

H

I

J

BYRON

CONCLUSION

The application of the recording densitometer to the interpretation of dot maps is an extension of the purpose for which the instrument was designed. There are, however, no theoretical barriers to overcome. Of the several kinds of densitometers only those that measure densities without repeated reference to the visual integration of emergent light intensities with optical wedges or comparison beams are practical to adapt to dot map requirements unless the problems involve pure cartographic experimentation. If the goal is to convert discontinuous distributions as represented by dots on a map into measurable continuities, the Brown Recorder must be used and the densitometer must be modified so that the map can be made to travel mechanically under the light.

The densitometer measures densities much as they are perceived by the human eye; but it also takes one additional step. The logarithmic function of opacity is automatically calculated so that both the meter and the recorder yield quantitative values of density on a scale which is proportional to the number of dots per unit of area. The subjectivity of visual response can thus be neutralized, for the densitometer has performed a measurement that is beyond the capabilities of the eye.

The densitometer will either count the dots or measure degrees of dot concentrations, according to the way in which the deflections are keyed into the map. The instrumental response depends in part on the map that it scans and in part on the variables inherent in the densitometer. As no two situations are ever exactly alike, the graphs must be calibrated each time any of the variables is changed.

If the densitometer is to be applied to area analysis, it is essential that certain cartographic procedures be observed. The dots must be of a uniform size and the background must be homogeneous. The map must include only dots, for any other symbols will nullify the density readings. The dots should be made very small, both to maintain the maximum density structure in places that approach coalescence and to utilize the full capacity of the densitometer. If these precautions are observed, there is almost no limit to the detail that can be preserved and measured on a dot map.

The main value of the densitometer technique lies in the ability of the instrument to translate unsystematic dot patterns into orderly line continuities. The graphs may be used in at least two basic ways. First, isopleth maps may be developed where the density structure will be a known quantitative element everywhere on the map. And second, the graphs may be used in an experimental way to determine what gray values most closely approximate a graded sequence of quantitative categories on a map. In either case, the cartographer has at his disposal a graphic representation of density that reduces the subjectivity of visual response to a fundamental minimum.

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The New Look in Soil Maps

The first of a new kind of soil map has just recently come off the press. The Soil Survey of Pasquotank County, North Carolina, prepared by the United States Department of Agriculture's Soil Conservation Service in cooperation with the North Carolina Agricultural Experiment Station and issued in October 1957, is the first of the new type of soil-survey reports which the U. S. Department of Agriculture and State agencies, working together on the National Cooperative Soil Survey, have adopted as standard for all such reports. The detailed soil-survey maps, on a scale of 1: 20,000 and measuring 11½ by 15 inches, have an aerial photomosaic background with soil boundaries and symbols overprinted in red. In the new atlas format, the maps are folded and bound with descriptive text in a booklet measuring 9¼ by 11½ inches, eliminating the separate large sheets used for the old line base maps. The format of the new series is much more practical for field use and study than were the large and unwieldy map sheets which accompanied previous county soil surveys. Copies may be purchased from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Design Criteria for Today's Aeronautical Charts

By LT. COL. LAVOI B. DAVIS

AERONAUTICAL CHART AND INFORMATION CENTER

TODAY'S aeronautical charts are designed to meet navigational requirements posed by equipment and operational techniques. These two factors are interdependent components of Air Force Weapons Systems. They are the most dynamic components because they guide the weapon movement. A complete weapons system includes the weapon; the related delivery component, such as the aircraft, its equipment, its crew, its operation technique; and the associated guidance system, such as ground based direction or control.

The Aeronautical Chart and Information Center has always considered the aeronautical chart a primary operational tool, an essential piece of equipment which supports a weapons system. It must, therefore, be designed to function as an inherent component of this system, and it will in turn be affected by the design and function of each of the other components. The aeronautical chart design is thus limited by the physical and functional characteristics of the entire weapons system and by man's capability of functioning as a component of this system.

Man is probably the most static of the weapons systems' components. He can be trained to a fine edge, he profits by experience and knowledge, and his physical capabilities can be extended by means of scientific aids. Nevertheless, he remains essentially a land-based being, susceptible to widely varying physiological and psychological limitations. He still remains the guiding force behind the weapons system, but in the not-too-distant future he may well be replaced by a mass of tubes and wire. The aeronautical chart is the pilot's graphic tool for navigation, therefore, the pilot's definable characteristics, abilities, mental habits, and physical restrictions impose direct limitations on the design of the chart.

Those engaged in some phase of mapping are familiar with the normal limitations imposed on cartographers in their attempts to portray a spheroid on a flat surface. They are aware of the problems created by scale, coverage, symbolization, materials, reproduction, and so forth. The scope of this paper is, therefore, confined to those technical limitations which are unique to the Air Force cartographer. Technical limitations are those operational factors which limit the areas of development, construction, design, and (to a certain extent) the use of an aeronautical chart. These factors include the chart user and those weapons-system limitations within which he must function, specifically the aircraft, its equipment, and the navigational technique. A few Air Force charting projects will be reviewed, and areas of technical limitations will be emphasized.

The first problem is concerned with the development of a new Pilotage Chart for visual navigation during a Low Altitude High Speed (LAHS) flight. When this type of mission was initiated, it became apparent that conventional charts would not satisfy the unique requirement of this navigational technique. Content and design of ordinary charts, based on flying requirements at average speeds and altitudes of propeller-type aircraft, were of little value to the hedgehopping jet airman. This was related to a number of physiological and psychological problems in this new type of navigation.

First, the pilot's field of vision during LAHS flight is limited in both horizontal and downward angle. In low altitude flight the distance required to recognize a check

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point is the same as for any aircraft at a given altitude, but the increased aircraft speed seriously limits the time available to see and recognize a feature on the ground. It would, for example, be normal for a "hill and dale" foot traveler to spend fifteen minutes studying his compass and visual references to obtain a precise locational "fix." Such a time-consuming procedure is not feasible for air navigation, for, at the not uncommon air speed of 1,000 miles an hour, a pilot might be 250 miles beyond the object he was trying to recognize in that time interval. Such speed forces the pilot to spend a minimum of time in recognizing and locating check points.

Distance of recognition is the distance at which an object of a particular size becomes recognizable. A four-story building, or an object of similar size, may be recognized, under ideal conditions, at a distance of about 20 miles, but an object of smaller size cannot be recognized until it is much nearer. Moreover, restricted visibility due to smoke, haze, dust, etc., may impose serious limitations on object recognition. Add to these factors the effect of the rapid approach to objects, which makes them appear to accelerate towards the observer; the fraction of a second available for recognition of certain type check points; the limited time for correlation of a ground object with a previously memorized abstract symbol (which must be recalled); and you can readily see the need for new concepts in the field of chart design. These limitations indicated the need for locating distinctive ground guidance features (check points) in such density that on any flight path the pilot could give primary attention to flying the aircraft and expend minor effort in navigating.

Even this does not complete the picture. The effect of turbulence during high speed flight is intensified in turbulent air close to the ground. This increases the physical and mental strain on the pilot who is already burdened, both physically and mentally, by frequent reference to charts inside a tight cockpit, and by the need for his close attention to operation and safe control of the aircraft.

Once the nature of the problem became clear, the job was to relate these operational considerations to chart content. Although chart features were considered in terms of design, the main objective at this point was to identify and establish the type and number of features required for safe navigation. It was apparent that preparation for a LAHS mission would include a particularly thorough briefing on the course of the aircraft. One of the prime functions of the chart would, therefore, be a "Memory Aid." It must include important terrain detail and other specific data that would serve as a reminder or aid to the pilot's memory during flight. Information to aid in navigation, such as unique cultural or natural objects which might serve as check points or turning points, and information that indicates the nature, position, and heights of obstructions in or near the flight path is most essential.

It was recognized that ground features, both cultural and natural, must be selected, not merely to reflect the basic character of the area but for their value as check points. The selection and portrayal of ground features, moreover, had to meet the requirement of rapid, visual recognition of prebriefed check points as seen from a low perspective angle. The selection criteria should include, therefore, the significance of the particular ground feature in relation to surrounding features. This "significance" or "uniqueness" may be expressed in vertical dimension, mass, design, configuration, color and color contrast, frequency or infrequency of appearance, etc. Furthermore, such feature points must form a network covering the entire chart area, in order to provide a check point for approximately every four minutes of flying time.

Besides check points, a pilot flying at treetop level is most concerned with avoiding obstacles. While such obstacles are ordinarily thought of as trees, or certain cultural features with vertical significance, in this LAHS situation, the irregularities of the ground surface itself may often constitute the most serious problem. This is particularly true when obstacles along a flight line occur with such frequency that it is

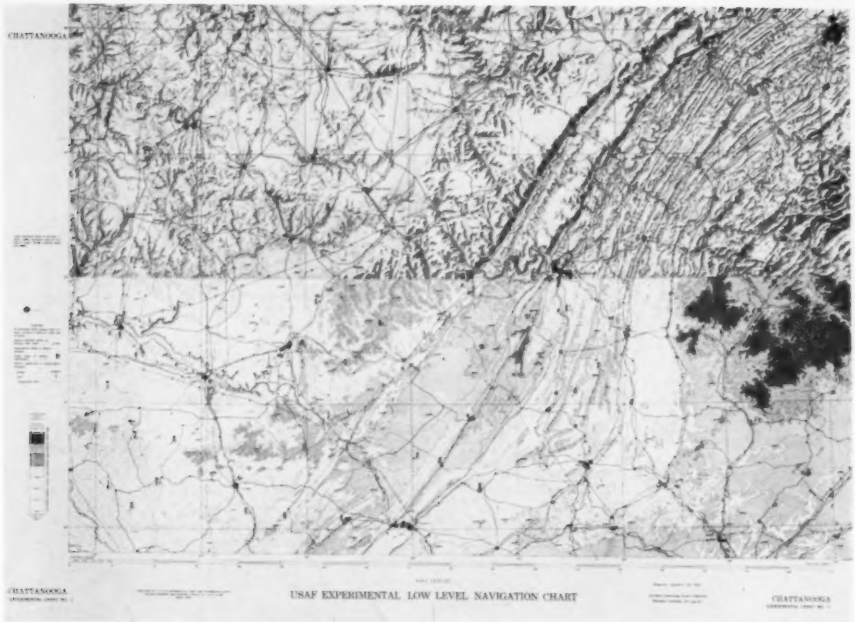


FIGURE 1.—Experimental Low Level Navigation Chart produced for evaluation by USAF users. The upper half of this chart contains a "shaded relief" portrayal; the lower half portrays only hypsometric tints.

neither efficient nor possible to try to avoid them individually. The vertically significant detail, therefore, must give the pilot enough information so that he may establish and maintain a minimum, safe-flight altitude along his entire route.

These two types of information—navigational check points and obstacles—although of dominant importance, do not comprise the entire chart content. This emphasized information must be placed in a familiar chart setting and be related to other features on the ground to form a whole picture, especially for preflight planning. The background must, therefore, be subdued but of sufficiently density and legibility to offer supplementary, flight-planning information.

Having determined the selection and density criteria for chart features, the next area of concern was design, i.e., *how* should these features be portrayed? A series of experimental prototypes was prepared. In these all design characteristic had to remain within the limits posed by the chart user and his needs during the LAHS mission. Two prototype graphics were accepted, after a field test and evaluation, and approved by USAF crew members.

Two types of relief portrayal, which were considered adequate for testing, are shown in Figure 1. The upper half of the chart combines a shaded-relief technique with a system of color tones denoting slopes. On the printed chart, green represents areas of less than 5° slope, whereas yellow denotes areas of slopes steeper than 5°. All peaks and ridges are accentuated by an orange cap. The lower half of this chart shows a revised, gradient-tint portrayal based on a 200-foot contour interval. Both charts contain newly developed pictorial symbols representing distinctive landmark features with vertical significance. Both also reflect attempts to subdue information not re-

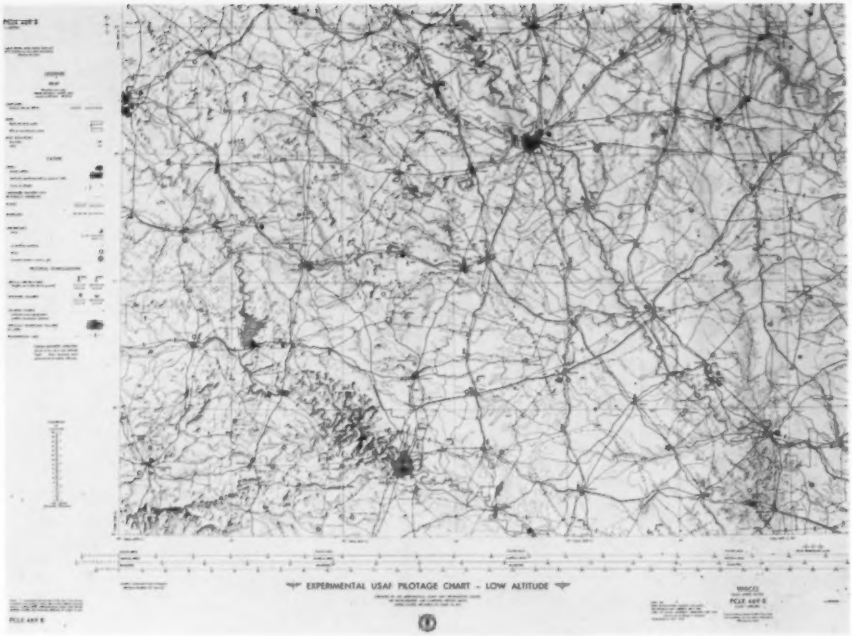


FIGURE 2.—PCLX 469B portraying a portion of Texas was produced for flight testing the low level chart during a low level mission.

quired for navigation and exaggeration of information needed for safe, accurate flight. Although either experimental chart would satisfy minimum requirements, it was agreed that the sample with "relative" relief or "slope shading" was preferred by the user. Much additional information was gathered to aid in improving the design.

The first full size USAF Pilotage Chart-Low Altitude, which represents a culmination of the ACIC PCL Chart Development effort is shown in Figure 2. The chart is labeled *Experimental* as it covers a US training area and because it is currently undergoing further tests by USAF units. The chart presents a clean uncluttered appearance, the terrain is accurately represented, there are sufficient check points to facilitate optimum ease of identification, and all possible obstructions to low altitude flight are clearly shown. All these features were required because of the technical limitations imposed by the LAHS system.

The portion of the chart in Figure 3 illustrates several points of interest. Note the simple yet effective portrayal. Roads are dark brown, railroads are in black. Both are limited to a network of recognizable check points when associated with other features. Urban areas are defined by their actual visual limits and are tinted violet for visibility under red as well as white light. The darker violet tint represents what may be called the "hard core" of the city, that is, the limits of vertically significant built-up areas. Several obstructions are symbolized by three-dimensional pictures, and the exact location of each feature is indicated by a small black star. Landmarks such as the stadium within the urban area, are pictorially symbolized.

In this close-up view, certain symbols are

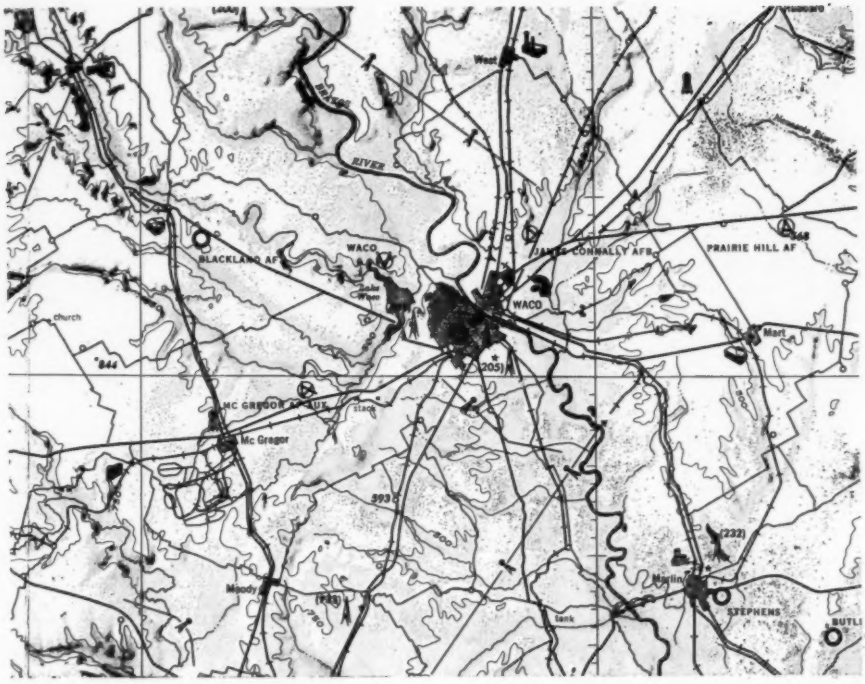


FIGURE 3.—Enlarged view of a portion of PCLX 469B centered on Waco, Texas. Notice pictorial symbols and 6,000-foot estimating aid circles around air fields such as James Connally AFB and Waco. The dark rectangle near the central part of Waco, just south of the Brazos River, is the core downtown area, i.e., the most visually significant portion of the built-up area.

in black and others in brown. On this particular chart, black symbols identify those features which are drawn from accurate photography or intelligence, whereas brown symbols express general characteristics of a feature for which no accurate picture is available. Major airdromes on this chart are shown in black by an exaggerated pattern of runways. The outer circle represents an arbitrary diameter of 6,000 feet to help determine the approximate length of runways. Minor fields are portrayed by a single grey circle.

Figure 4 presents an area of higher relief, and illustrates the new method of differentiating broad types of geographic areas by color. Relatively level terrain is shown in green. Hilly or mountainous terrain is portrayed by a combination of shaded relief and light buff-tone underprint. Contours are printed grey at 250-foot intervals, and the orange tint is used sparingly to accentuate peaks and ridges. Other new features include printing place names in grey to reduce clutter, transmission lines are shown prominently in black with frequently spaced tower symbols, and 30-minute isogonic lines, with local anomalies, are in grey.

As new techniques or better portrayals are developed, they are entered on new and more advanced prototypes. Optimum techniques and portrayal are applied to all chart series whenever scale and use permit. Concepts of chart design at every step in this development program are definitely geared to the physiological and psychological problems of the pilot and to his immediate environment.

FIGURE 4.—Although in monochrome, the rugged character of the terrain in the Voges and Black Forest regions of France and Germany shows up very well.

Limitations imposed by the development of new navigation equipment also posed problems. This problem clearly points up the fact that aeronautical charts are a unique member of the cartographic family. It involves a set of experimental graphics, now undergoing development at ACIC, which are designed for use with a new cockpit projection system. These graphics will, of course, undergo extensive evaluation by the Air Force before acceptance. The cockpit projection system incorporates an airborne chart display instrument that presents a realistic pictorial plan of the various phases of jet operations, superimposed over a graphic representation of the earth's surface. It is designed for use in high altitude, high speed, single place aircraft. This system, after final evaluation, may provide the answer to the question, "How can a jet aircraft fighter pilot, flying at short range, at speeds in excess of mach 1.0 and at altitudes up to 50,000 feet, still find time to navigate?"

The chart display feature of this cockpit projection system consists of a graphic portrayal, pre-selected from a magazine of reference charts which show topographic and aeronautical information. The charts are actually miniature film positives which are projected onto a 10-inch screen positioned 30 inches from the pilot and somewhat below his eye level. Each chart image is fixed and oriented so that magnetic north (at the chart center) is always at top center of the viewing surface. A maximum flight range consisting of circles of varying diameters is centered on the aircraft symbol to indicate the distance the aircraft can fly in any direction. It is primarily a relationship between fuel remaining, fuel consumption rate, and aircraft altitude. Except for the selection of chart area and scale, the operations accomplished by the equipment are continuous and automatic.

Most conventional ideas on cartography had to be discarded during this development program, as well as before it began. This

work was in an entirely different medium. New graphics were required which could be reproduced on 35 mm film strip, in color, and withstand extensive use at temperatures estimated to be over 100° Fahrenheit. The chart image must be precisely positioned on the film so that the image center projects exactly to the center of the chart display area. It is obvious, therefore, that the materials and physical construction of these graphics are indeed limited by the capabilities and characteristics of the equipment itself.

But what of chart design and content? Three separate charts are required. Scales vary from one inch equals forty nautical miles to one inch equals five nautical miles. Each, of course, is designed for a different phase of the navigational mission. The smaller scale charts are used for cross-country navigation. The requirement, therefore, dictates the selection of detail to be shown—in this case, base information usable for pilotage at the service ceiling of high altitude aircraft. Aeronautical information consists of selected air bases and electronic navigation facilities.

The chart at scale 1:729,620 is used for penetration type operations, such as entering into terminal areas. The selection and density of base chart detail are based on more liberal criteria than for the small scale chart. Generally, the aeronautical overprint will include rendezvous and holding points, entrance and departure patterns, altitudes and procedures, airspace restricted areas, and other associated navigational data. The large scale chart is used for approach and landing operations. It must show obstacles of both cultural and relief types, a definite pattern of check points for visual reference, and a mass of airfield and electronic navigational information.

To meet accuracy requirements of the projection equipment, all chart features are positioned and aligned with extreme care. It is estimated that the combined inaccuracies after compilation and construction of film strips can be no more than one part in 500 for any area portrayed. In addition, the line weights, type styles and sizes, and all symbols must provide a high degree of legibility under both white and red light at a viewing distance of 28 to 30 inches. These factors alone, if considered for just a single feature, pose a most difficult problem. But, unfortunately, chart features are like taxes, they multiply. To provide not only base information necessary for pilotage navigation, but also aeronautical information which must satisfy at least twelve different types of electronic equipment capabilities within a 10-inch circle, calls for unusual ingenuity.

First attempts were not wholly satisfactory. The severe limitations of size, material, and viewing requirements were not at all compatible with the amount of information which had to be portrayed. Obviously some compromise had to be made. Based on knowledge of the operational needs of the pilot, it was necessary to formulate criteria for selecting topographic detail, which were listed in order of importance. When the portrayal of base chart detail and aeronautical information conflicts and produces a cluttered condition, preferences are given to aeronautical information. Even this was not sufficient, however, and it soon became clear that the detail retained must have a direct functional application, that is, features presented must be given prominence in proportion to their value as a direct aid to mission accomplishment. Thus, obstacles and terrain clearances, such as radio towers and mountain peaks, are placed at the top of the list, followed by aeronautical information, terrain and cultural detail, and tactical data.

Similar criteria had to be established for selecting and portraying aeronautical information. It was necessary to design, what might be called more functional symbols. This was extremely necessary because the initial experiments were limited to black-and-white film. This limited design considerations to lines and masses. A suitable color film is under development which will simplify the design task, but for the present all the required data must be presented in a legible concise form. Thus, this project has called for new and revised cartographic concepts and techniques to meet the capabilities and intended operational uses of the cockpit projection equipment.

The first attempt to satisfy this graphic requirement contained just about all the detail ideally required by the pilot. Unfortunately, its readability was limited because of the vast amount of information portrayed. After consideration of the optimum needs, the final graphics more nearly represented the answer to the problem. The 400-mile chart shown in Figure 5 appears on the screen at the approximate scale of 1:3,000,000 or 40 miles to the inch. This chart is used for general navigation. Observe that no transportation network is shown at this scale. The chart does, however, portray air-

FIGURE 5.—The smallest scale 35mm film chart with a diameter of 400 nautical miles is used for general enroute navigation. Although reduced in size in this article, all of these film charts project up to 10 inches in diameter.

fields with paved runways longer than 5,000 feet, as well as all usable Radio Facility information, such as identification, frequencies, and availability of ILS and OCA. Terrain is shown by shaded relief and spot elevations. Coast lines, city outlines, major drainage, and other prominent visual landmarks, as well as international boundaries and restricted areas, are indicated.

Figure 6 shows the 100-mile chart at a scale of 1:729,624, or ten nautical miles to the inch. It is used for terminal area operations, such as scrambles, takeoffs, and aircraft recoveries. A more important feature of this chart is the procedure for

FIGURE 6.—The intermediate scale 35mm film chart with a diameter of 100 nautical miles is used for operations in the vicinity of aerodromes, such as during scrambles and recoveries.

scramble and recovery. This chart does show a limited transportation network. The final chart appears on the screen at 1:364,812 or five nautical miles to the inch. (Figure 7.) This is the approach and landing chart on which topographic detail is designed to give the pilot information by which he can check his position at low altitudes. It should be noted that only jet procedures are shown.

FIGURE 7.—The largest scale 35mm film chart with a diameter of 50 nautical miles is used for the approach and landing phases of flight.

In this paper only a few of the many operational considerations affecting design criteria for aeronautical charts have been described. They have demonstrated how these criteria have forced ACIC cartographers to function outside normal cartographic practices in their exploration of extraordinary areas of design. These have been exacting but fascinating excursions. The "Problem-Solution" team in the field of design and development is becoming more competent in identifying limitations and building an accurate product on their foundations.

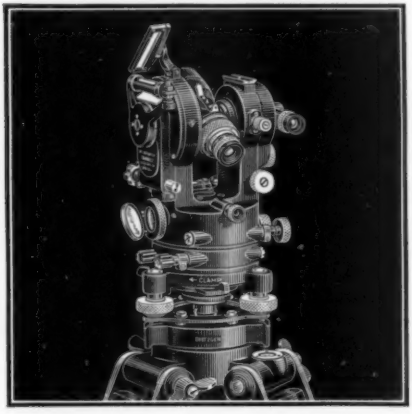
Anyone who has given serious thought to the navigation problems which will exist within the next few decades when space flight becomes a reality, has been forced to examine in his mind the type graphics which will be needed. The old problem of portraying the earth on a flat piece of paper will appear child-like in its simplicity when compared with the complexities of designing spatial graphics. These operational complexities, as they evolve, will force an even greater departure from existing mapping and charting techniques. Technical charting problems for future weapons systems will require new methods, techniques, and portrayal media as radical as the differences existing between the sea-shell maps on the sand, as drawn by the primitive islanders, and the present aeronautical charts.

New Chart Covers Canaveral Harbor

The Coast and Geodetic Survey has announced the publication of a new chart (No. 456) providing coverage of Canaveral Harbor, the only deep-water port on the east coast of Florida between St. Augustine and Fort Pierce. The chart is at the scale of 1: 10,000 and shows in detail the approaches to and the dock facilities of this important manmade harbor.

Canaveral Harbor provides a turning basin with a depth of 27 feet, a width of about 1,000 feet, and a length of about 1,900 feet.

The chart is priced at $0.25 and may be obtained from the Washington office of the Survey, district offices, or sales agents.



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The Evolution of Surveying Instruments*

By R. S. BURNSIDE, JR.

SURVEY ANALYST, SHELL OIL COMPANY

SURVEYING, that is the type of survey- about which this article is written, is defined in the *Thorndyke-Barnhart Dictionary* as "business or act of making surveys of land." Surveyor is defined in the same source as "person who surveys, esp. land." In the course of my experience as a land surveyor, I have been called, and heard other surveyors called, far less complimentary names in much more explicit terms.

The practice of surveying portions of the earth's surface is older than any written record that has been uncovered up to this time. In the *Iliad* and the *Odyssey,* epic poems ascribed to the blind Grecian poet, Homer, some translators find what they interpret to be references to surveying practices in existence at the time of the Trojan Wars in the early twelfth century B.C.

Probably the oldest known reference to surveying in a document is found in an old Sanscrit manuscript in which it is stated that the Chaldeans (Babylonians) estimated 4000 steps of a camel to be equal to one mile and that 66.25 of such miles were equal to one degree of latitude, and further, from that data, 24,000 miles were deduced as the circumference of the earth.

The earliest measurements were probably made by using some part of the human body, such as the foot or forearm. In fact, some of our present units of measurement are based on the accumulated length of the feet of a number of men who happened to be first in leaving a gathering.

EGYPTIAN CONTRIBUTIONS

Inscriptions on the Palermo Stone, which recorded events during the II Egyptian Dynasty of about 3000 B.C., show river-gage readings and "numbering of gold and lands." During this same period records indicate that there was registration in the royal archives or registry of property belonging to certain officials. This would tend to prove that at this early date there already existed in Egypt a well developed method of measuring the land and of computing the area of properties, while the registration of ownership and measurements was becoming highly organized, this being essential in a country where all payments of taxes were made in kind and rent was paid in the same way.

Of interest to our lawyer friends is the record of a lawsuit which was tried in the Egyptian courts about 1580 B.C. The dispute was between two men who each claimed title to the same tract of land—an occurrence not uncommon today. The case was first decided in favor of one of the men who was able to produce for the court false title deeds. On appeal, the decision was reversed when testimony of adjoining landowners was taken.

Although we do not have maps of landed property in ancient Egypt, we do find on some of the old tomb walls, representations of land measurers, or surveyors, at work. One such scene depicts two chainmen measuring a field of corn with a long cord on which are knots or marks at regular intervals.

Each chainman is carrying a spare cord coiled up on his arm, and walking beside them are three officials who carry writing materials and who are accompanied by a small boy carrying writing materials and a bag in which are probably documents and plans referring to the property. An old man and two boys, probably the landowner and his sons, also accompany the surveyors, and a peasant brings a loaf of bread and a bunch of green corn.

There are several other tomb pictures depicting the measuring cord, and in several

* This paper, which was originally published in the March 1957 issue of *New Oiler,* A Shell Oil Company publication, is being republished in SURVEYING AND MAPPING in the belief that it will be of interest to many of our readers who might otherwise never see it.

—EDITOR

instances the cord is shown to end in grips in the shape of a ram's head. The ram was an object of worship to the Egyptians and indications are that some of the surveyors were also connected with the priesthood in some manner. I do not think this is the picture that enters the mind of an average layman when he thinks of the surveyor of today.

During the past century, a great number of papyrus records concerning measurements, registration and qualities of lands in Egypt have been recovered from ancient tombs, which indicates the importance and extent of the work at that time.

The ancient Egyptians marked their boundaries well, and some of these markers set as early as the time of King Ikhnaton, who ruled from 1375 to 1378 B.C., are still in existence. The recorded distances between these monuments are remarkably close to distances arrived at by using modern surveying instruments and methods.

Instruments for obtaining an accurate bearing were used by the Egyptians at a very early date. A check of the Pyramid of Cheops near Giza discloses that the base of the pyramid is laid out in an almost perfect square and that it is oriented only 3′ 06″ west of a true-north meridian. These amazing results were obtained by use of a "merkhet" or plumb line in connection with circumpolar stars.

This instrument was in use in Egypt from very early times and consisted of a short plumb line and plummet hanging from a holder. This was sighted on any object by looking through a cleft piece of the center rib of a palm leaf as a sight vane. It was used for setting out a line in any selected direction with the aid of terrestrial marks or a celestial body such as the sun or a star.

This procedure is referred to in the inscription on the Palermo Stone and is doubtless a survival from a very early time when primitive shrines were actually set out on a bearing so determined. The remarkably square bases of the pyramids were laid out by use of right triangles constructed on the 3: 4: 5 sides principle, which was the basis of the Pythagorean theorem and the advancement of the science of mathematics by the Greeks, Euclid and Archimedes.

The early Egyptians also attained a very satisfactory accuracy in leveling, and of this the Great Pyramid at Giza furnishes proof. The rock pavement on which the Pyramid was built was carefully leveled before construction was begun, and investigations reveal that it was very successfully done. The pavement surface was found to have a slope of only 6mm from east to west and 14mm from north to south, over a distance of 230 meters in each case, or 1 in 38,000 and 1 in 16,500 approximately. On some of the ancient Egyptian structures, it is possible still to find leveling lines marked at regular intervals in order to provide the masons with a control for their work.

There is evidence to support the idea that the Egyptian surveyors carried out a line of leveling from the First Cataract of the Nile to the Delta with a very fair degree of accuracy. The average slope over this distance, based on the old surveyors' work, is 1 in 14,440 while that obtained by the modern irrigation service is 1 in 13,700. The instrument used to obtain this accuracy may well have been the right-angle isoceles triangle of wood, with a plumb line attached to the apex, such as the masons used. It would have been placed on a long wooden straightedge, which in turn rested on pickets. In this way, leveling of a very fair accuracy could be attained quite rapidly.

It appears that the principal contribution of the Babylonians, who were more interested in astronomy, to surveying, was the division of the circle into 360 degrees. They based this on the movement of the sun, each degree being a measure of one day's progress of that body along its path, knowing, however, that a yearly cycle was slightly more than 360 days.

The great geographer, Ptolemy, is said to have had a circle engraved upon stone by which, in his observations, he estimated angles to single minutes. If this report is true, we have a remarkable instance of mechanical skill and early geometrical con-

ception and precision. The circle must have had a very large diameter to permit such a degree of accuracy, because the subdivision of a degree into fractions by means of a vernier was not done until 1631 when Pierre Vernier, a Frenchman, invented the vernier we use today.

ROMAN PROGRESS

It is not until Graeco-Roman times that any surveying instruments other than the measuring cord and rod, the "merkhet" for obtaining bearings, and the triangle and plumb line for leveling are met with. The first instrument other than those above on which we have information is the "groma." It was widely employed in Italy, where the Romans attributed it to the Estruscans, but it was also in use in Egypt, so it seems possible that Egypt may have been the place of its origin as well.

Although more than one form of it is known, the groma consisted essentially of two plumb lines suspended from the ends of each two rods which were set at right angles to one another. Such a pair of plumb lines with the wooden rod which carries them at its extremities is, in fact, a double "merkhet," and it is not impossible that it was developed by some Greek engineer who, being familiar with the use of the merkhet in Egypt, realized the advantages of an instrument with which both alignments could be laid out and lines set out at right angles to one another. Enough well preserved parts of the groma were found in one of the houses of the Via Abbondanza of Pompeii so that the design could be accurately copied. It consists, essentially, of three parts: (1) the iron shoe or point which was driven into the ground; (2) the column, and the projecting arm which enabled the surveyor to bring the center of the cross vertically above the center of the boundary stone beside which the groma had been placed; (3) the cross, formed of two rods set at right angles to each other, and from the extremities of which plumb lines were suspended. When one pair of these plumb lines were aligned along a line previously established, other lines at right angles could then be laid out by means of the other pair.

The groma was finally supplanted about 125 B.C. by an instrument called the "dioptra" which was supposedly invented by Hero of Alexandria, who wrote an accurate and detailed description of the instrument in a treatise. Unfortunately, the eleventh century codex of this treatise, which is preserved at the Bibliotheque National in Paris, is incomplete at some part of the description, so a reconstruction of the instrument is not easy. With the dioptra, not only could lines be laid out in any direction and vertical angles measured, but leveling could be done. The dioptra consisted of a peep-sight mounted on an alidade, pivoted in the center, and moving about a circular disc which was divided into 360 single degree divisions.

With gears and clamps, the alidade and disc could be rotated about both a horizontal and a verticle axis, but since the instrument, in the form just described, could not be used for leveling, it was necessary to adopt other means. The disc and alidade were removed and a grooved wooden bar was mounted on the pedestal. In this groove was placed a bronze tube about eight feet long, and in the ends of this tube, two "ells" were fastened. In each "ell" there was a water column. With these two water columns, a level line of sight could be established.

It was by the Romans that the art of surveying was first recognized as a profession. The Roman surveyors were called "agrimensores" and their work consisted chiefly of surveying military camps, roads, aqueducts, and property lines. The Romans had accurate linear measurements of their military road system which extended from North Africa to the British Isles and eastward into Asia. No record of any horizontal angular measurements for those roads are found.

Surveying was so popular during one phase of the Roman culture that a university teacher made the statement that all the young men were deserting the study of the other arts and sciences and going out into the field to work with the surveyors.

Another instrument contributed to surveying by the Romans was the chorobates. The chorobates was designed for leveling only and consisted of a straightedge about twenty feet long with short strips or legs fastened at right angles to each end. Braces were placed between the legs and the straightedge. Plumb bobs were suspended from positions near the ends of the straightedge and marks were made on the braces the same distance from the legs as the points of suspension of the plumb lines. This instrument is very similar to the one with which the Egyptians probably did their work, except for one important refinement. The Romans cut a groove about five feet long in the top of the straightedge. This groove was filled with water so that a level position could be determined when there was too much wind to work with the plumb lines.

One of the oldest instruments still to be found in use today is the astrolabe. This was originally an astronomical instrument used for finding the altitudes of stars, and is known to have been used as far back as 200 B.C. Geoffrey Chaucer must have been quite well informed on a variety of subjects, since he wrote a treatise on the astrolabe in 1391, which described essentially the same instrument which was in use in 200 B.C. I'm sure, however, that his Canterbury Tales were more widely read and enjoyed than was his treatise on the astrolabe.

EUROPE AWAKENS

Progress in the evolution of surveying instruments and methods virtually stopped at the time of the fall of the Roman Empire, and it was not until the early fifteenth century that interest in improvements began to appear. In 1556, Georg Agricola, a German scientist, wrote and had published a book describing the type of compass then used for laying out tunnels and mine shafts.

Thomas Diggs, an English mathematician and surveyor, published, in 1571, a book in which he described his "Topographicall Instrument." Part of this instrument was a horizontal disc which Diggs called the "theodolitus," from which we get the name of our theodolite. It is almost laughable to compare the Diggs instrument to the theodolite of today, until you realize that our instrument evolved from his.

Trigonometric surveying or triangulation by application of the theodolite is reputed to have been used as early as 1615 when the instrument still had open sights. The telescopic sight, developed by Galileo, an Italian astronomer, in 1609, is supposed to have been used for the first time by a French surveyor, Picard. Picard is also given credit by some for placing spider lines to indicate the focus in 1669. William Gascoigne, a young Englsh scientist, who had previously invented the micrometer, used silk threads for cross hairs and is credited by others as being first to introduce them to surveying instruments.

I have mentioned previously the fact that the Frenchman, Pierre Vernier, in 1631, invented the vernier as we know it today. This was an enourous step forward in the direction of accuracy, but just as important was the development in the 1770's of a machine for the purpose of dividing astronomical and surveying circles by mechanical means rather than by hand, as had been done up to that time. This machine was invented by the celebrated Englishman, Ramsden, who recognized the need for it when he noticed that use of the instruments then available produced such varying results.

The system introduced by Ramsden was soon adopted throughout Europe, and from that period geodetic surveying may be said to be placed upon a more certain and perfect basis. Using his machine, Ramsden constructed his great theodolite, 36 inches in diameter, the divisions of the horizontal circle being subdivided by means of micrometrical microscopes to read to a single second of arc. The telescope of this instrument had a focal length of 36 inches. It is curious to note that this instrument, made in the 1770's, is still preserved in England in perfect condition.

Ramsden made a further contribution toward more accurate surveying by preparing a steel tape which was more accurate than any developed to that time.

When the telescope was first used on the theodolite, it was too long to permit "plunging" or turning through 180 degrees of vertical arc. This made its use awkward and inconvenient until the idea was developed of shortening the telescope and raising the standards on which it rests, so that the telescope could be plunged rather than having to turn a horizontal angle of 180° in order to extend a straight line.

The telescope with cross hairs did not make obsolete the peepsight type which was used in mine and land surveying until after the middle of the nineteenth century. In fact, instruments of the peepsight type were used by George Washington, Thomas Jefferson, and many other famous individuals who were also surveyors.

The College of William and Mary in Virginia by its 1693 charter was made Surveyor General of the Colony of Virginia and the faculty of the college was entrusted with the duty of examining surveyors and issuing them licenses. George Washington, in 1749, at the age of seventeen, was licensed a surveyor by this college and practiced as a professional surveyor until other duties forced him to discontinue.

I remember an instance of interest that I ran across while studying the field notes of a surveyor who was making a government survey of public lands in Union Parish, Louisiana, back in the early 1800's. It seems that this surveyor in attempting to cross a creek on a log had fallen in. In his notes he had drawn a hand with the forefinger pointing to a note which read, "Fell in creek. Lost my compass and ruined my notes. 100,000 acres this land not worth 1 cent." That land was at the time covered with virgin pine and cypress timber which is practically nonexistent and very valuable now. There is also an oil field there which, although not as prolific as some in other places, is also quite valuable.

Judging from the difficulty encountered when an attempt is made to follow some of the surveyors who made the early land surveys in this country, in southern Louisiana in particular, it would seem that the surveyors did not even trouble to take an instrument with them when they were doing the work.

The modern transits, theodolites, levels, and other surveying instruments are much different from the instruments used during the time of the Egyptian rope stretchers. These instruments have become functional to the extent that they are now in many phases of man's every day living and progress. A 3½-inch Microptic Theodolite was adapted for use with a camera and accompanied Sir Edmund Hilary on his conquest of Mt. Everest in 1953. The 36-inch instrument constructed by Ramsden and the less accurate and bulkier instruments in use before his could not have been used for such an undertaking and, consequently, records of the expedition would have been less accurate and complete.

There has been enormous improvement in the instruments used for surveying during the last few years, and we can hope that there will be continued and greater advances during the years to come.

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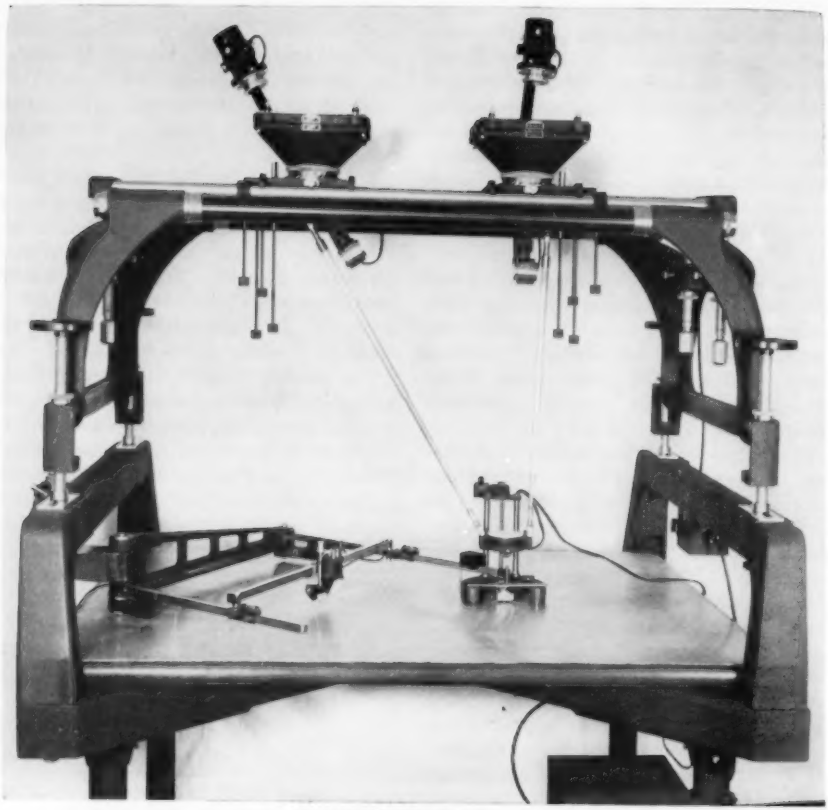

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Surveyors' Day Celebrated at Historic College of William and Mary

SURVEYORS from seven States and the District of Columbia registered at the Surveyors' Day meeting and exhibit of historic surveying instruments held at the College of William and Mary, Williamsburg, Virginia, on August 23, 1957. The meetings and exhibits were held in the new Phi Beta Kappa Memorial Hall. In view of William and Mary's role in the early days of American Surveying, the time and place were most fitting and proper in special observance in honor of the surveying profession as a feature of the elaborate 1957 Jamestown Festival celebrating the 350th anniversary of the founding of the Virginia Colonies.

It was from William and Mary, chartered in 1693 and housed in the famous Wren Building in 1695, that George Washington in 1749 received his first public office—a license to practice surveying; the College officially being the Surveyor-General of the Colony of Virginia, and its faculty entrusted with the duty of examining and licensing surveyors. As indicated by William and Mary President Alvin Duke Chandler and the College's Librarian Emeritus, Dr. Earl Gregg Swem, "The relationship of the College to surveying in the colonies was a particularly close one and this occasion of Surveyors' Day is timely for us to emphasize, not only the important role William and Mary played in colonial times, but also the importance of the surveying profession to the world today."

THE EXHIBITS

Some 28 items of historic surveying instruments and equipment were displayed exceptionally well under glass in several locked cases arranged within the spacious exhibit hall. The exhibits were to remain on public exhibition for thirty days. It is believed that this was the greatest United States assembly of historical surveying instruments. This exhibit jointly sponsored by the American Congress on Surveying and Mapping, the Virginia Association of Surveyors, and the College, was presented by ACSM Instruments Division under the chairmanship of Clifford A. Thorpe, Jr., ably assisted by members of Thorpe-Smith Inc., of Falls Church, Virginia. Credits for the displayed items appeared on cards describing each item. (A list of the 28 items exhibited appears at the end of this article.)

Also displayed in the main foyer were copies of historic maps from the National Archives, the ones shown by means of color-slides in illustration of the paper by Herman R. Friis. This display afforded an opportunity for more leisurely examination and study of these maps than was possible by the brief showing on the screen.

Both exhibits delighted those fortunate enough to be in attendance at the meeting.

THE PROGRAM

The program was a panel discussion of "The History of Surveying in the United States."

Morning Session: Walter S. Dix, Executive Secretary of ACSM presided and introduced Dean Charles F. Marsh, speaking for William and Mary's President Alvin Duke Chandler who was unable to attend, who discussed the background of surveying in early Virginia.

Greetings were presented by President Frank A. Rose of Transylvania College, founded when Kentucky was a district of Virginia. West Virginia University was represented by Jack C. Burdette, chief of the Real Estate divisions of the U. S. Army Engineers, an alumnus presenting greetings for his alma mater.

Herman R. Friis, Chief, Cartographic Records Division, National Archives, gave a slide-illustrated lecture on "Highlights in the History of the First Hundred Years of Geographical Exploration and Surveying and Mapping by the Federal Government, 1775–1875."

Afternoon Session: Dr. Robert H. Randall of the Bureau of the Budget opened the

THE CARTOGRAPHIC DISPLAY—SURVEYORS' DAY CELEBRATION

afternoon session with brief histories of the major mapping and surveying agencies of the Federal Government, and then enlarged upon developments to present times and the expanded importance of both *making* maps and surveys and of *using* them, and the modern trends and concepts and the increasing acceptance of the importance of basic mapping programs to national development and to hemispheric development, in fact to world development.

Donald B. Clement, Cadastral Engineering Officer, Bureau of Land Management, concluded the panel presentation of surveying history with his very informative paper "Public Land Surveys—History and Accomplishments."

It is the present plan to publish the four papers presented at the Surveyors' Day meeting in a future issue or issues of SURVEYING AND MAPPING. —EDITOR

Before adjournment, Chairman Dix introduced Edmond R. Kiely, Ph.D., a Brother from Iona College, New Rochelle, N. Y., who was in the audience, and who was the author of *Surveying Instruments—Their History and Classroom Use,* which was selected by the National Council of

Photograph by Victor H. Ghent

SURVEYORS' DAY LUNCHEON AT WILLIAMSBURG LODGE

INSTRUMENTS FROM THE SURVEYORS' DAY EXHIBIT

Walter S. Dix, Executive Secretary, ACSM, holds a transit used by Admiral Byrd at both the North and South Poles, and Dr. John T. Baldwin, Jr., College of William and Mary, holds an old compass with a transit telescope, while Herman R. Friis, Chief, Cartographic Records Division, National Archives, looks on. Photography by Thomas L. Williams, Williamsburg, Va.

Teachers of Mathematics as their 19th Yearbook in 1947, and was published that same year by Teachers College, Columbia University. Recognized for this masterful work, he received a warm ovation from the assembly.

Dr. John T. Baldwin, Jr., who is director of William and Mary's participation in the Jamestown Festival and was the coordinator of the efforts of the College, the Virginia Association of Surveyors, and ACSM, in arranging for "Surveyors' Day," was thanked for the most enjoyable affair which included an excellent luncheon at the Williamsburg Lodge at noon, attended by nearly a hundred of the registered guests and hosts. Dr. Baldwin received applause well deserved.

Chairman Thorpe was roundly applauded for his very excellent displaying of the collection of historic surveying instruments on exhibit.

President Daniel M. Maher of the Virginia Association of Surveyors made the closing announcement with an invitation to everyone to attend their scheduled evening of cocktails and social pleasantries at the Lodge.

HISTORICAL INSTRUMENTS

Descriptive list of historical instruments which were assembled for display in connection with the Surveyors' Day meetings at the College of William and Mary in Virginia on August 23, 1957, at Williamsburg, Va. This exhibit, jointly sponsored by the American Congress on Surveying and Mapping, the Virginia Associations of Surveyors, and the College, was presented by

HISTORIC SURVEYING INSTRUMENTS DISPLAYED AT WILLIAMSBURG

The exhibit, largest of its kind ever assembled in the United States, included an ancient astrolabe, approximately 2,000 years old, which was found by archaeologists in the place known today as Iraq; a surveyor's compass made in England in 1700 and used by George Washington; a theodolite personally owned by Thomas Jefferson; a melted transit, relic of the San Francisco fire; the small transit used by Admiral Byrd in both the North and South Polar Regions; the first transit made in the United States; and the first aluminum transit, which was also the first commercial use of aluminum in the United States. Photograph by Thomas L. Williams, Williamsburg, Va.

ACSM Instruments Division under the chairmanship of Clifford A. Thorpe, Jr., assisted by members of Thorpe-Smith Inc., of Falls Church, Va.

The information in the following descriptive list of the items exhibited was taken from the display cards which were shown with the instruments.

1. Thomas Jefferson's Theodolite: Made by W. & T. Gilbert, London, England, circa 1800. Descended through the Tucker, Smith, and Kent families. Loaned by: Thomas Jefferson Memorial Foundation.

2. Surveyor's Compass: Made by Goldsmith Chandlee, Winchester, England, circa 1710. Used originally by: Henry Gunnell; Col. George West Gunnell; J. Owens Berry, Capt., C.S.A. Loaned by: Joseph Berry, Vienna, Va.

3. Surveyor's Compass: Made by Goldsmith Chandlee, Winchester, England, 1710. Mr. R. L. Tatum has traced the ownership of this instrument to being one of the first ever owned and used by George Washington. Loaned by: R. L. Tatum, Taylorsville, N. C.

4. Steel Tapes: Manufactured by the Lufkin Rule Company. This is a collection of tapes manufactured between 1869 and the early 20th century. Loaned by: The Lufkin Rule Company, Saginaw, Mich.

5. Astrolabe: Maker unknown, circa 50 B.C. This instrument was found in Iraq by an archaeologist and is believed to be approximately 2000 years of age. The small compass attached to the astrolable is believed to have been added some time later. Loaned by: W. & L. E. Gurley, Troy, N. Y.

6. Hoop Compass: Maker unknown, circa 1750. This compass is the type used during the time of George Washington for making surveys throughout Virginia and the other colonies. Loaned by: W. & L. E. Gurley, Troy, N. Y.

7. Small Byrd Explorer's Level: Manufactured by W. & L. E. Gurley, Troy, N. Y. This instrument was used in Admiral Byrd's Expeditions to both the Arctic and the Antarctic. Loaned by: W. & L. E. Gurley, Troy, N. Y.

8. Admiral Richard E. Byrd Transit: Manufactured by W. & L. E. Gurley, Troy, N. Y., 1930. This transit is the one used by the first Byrd Antarctic Expedition of 1933, and was also used by Admiral Byrd at the North Pole. Loaned by: W. & L. E. Gurley, Troy, N. Y.

9. Hell Gate Transit: Manufactured by W. & L. E. Gurley, Troy, N. Y., 1915. This 10-second transit was designed by Gurley to control the erection of the Hell Gate Bridge in New York. Loaned by: Pennsylvania R. R.

10. No. 77-X Transit: Manufactured by W. & L. E. Gurley, Troy, N. Y., circa 1879. This instrument was manufactured just prior to the first aluminum transit. Loaned by: W. & L. E. Gurley, Troy, N. Y.

11. Burt Solar Compass: Manufactured by W. & L. E. Gurley, Troy, N. Y., 1880. This compass was one of the first uses of aluminum in the United States. Previously all such compasses had been made of brass or bronze. Loaned by: W. & L. E. Gurley, Troy, N. Y.

12. Double Telescope Transit: Manufactured by W. & L. E. Gurley, Troy, N. Y., circa 1855. This instrument was meant to be used in such manner that the instrumentman would not have to turn his plate 180° in order to take a backsight. He would use one telescope taking his foresight and then walk around the instrument 180° and use the other telescope to take a backsight. Loaned by: W. & L. E. Gurley, Troy, N. Y.

13. First Aluminum Transit: Manufactured by W. & L. E. Gurley, Troy, N. Y., 1867. This light mountain transit (8½ lbs.) was made of aluminum for the U. S. Centennial Exposition. Reported to be the first commercial use of that metal in the United States. The aluminum for this transit was imported from France. Loaned by: W. & L. E. Gurley, Troy, N. Y.

14. Phelps & Gurley Transit: Manufactured by W. & L. E. Gurley, Troy, N. Y., circa 1845. This is one of the first original transits made by W. & L. E. Gurley Co. Loaned by: W. & L. E. Gurley, Troy, N. Y.

15. Theodolite: Made by Fauth & Sons, Washington, D. C., circa 1850. This is a 2-second theodolite made especially for the U. S. Geological Survey for use in mountainous triangulation surveys from 1880 to early 1900. The last known survey in which this type of instrument was used was in the Great Smokey Mountain National Park. Loaned by: U. S. Geological Survey, Washington, D. C.

16. Early Surveyor's Transit: Made by James Reed & Company, Pittsburgh, Pa., circa 1800. Loaned by: U. S. Geological Survey, Washington, D. C.

17. Micrometer Alidade: Manufactured by W. & L. E. Gurley, Troy, N. Y., circa 1900. This instrument was especially made for the U. S. Geological Survey. Loaned by: U. S. Geological Survey, Washington, D. C.

18. Compass with Transit Telescope: Manufactured by W. & L. E. Gurley, Troy, N. Y., circa 1870. Gives levels and grades with accuracy sufficient for ordinary purposes. Loaned by: The Smithsonian Institution, Washington, D. C.

19. Telescopic Alidade: Maker unknown, circa 1890. This alidade was used by the U. S. Geological Survey. Inverted image, external telescope. Loaned by: The Smithsonian Institution, Washington, D. C.

20. Gunter's Chain: Invented by Edmund Gunter, circa 1620. This chain was used until late 19th century in land measurement. Loaned by: The Smithsonian Institution, Washington, D. C.

21. Theodolite: Made by L. Casella, London, England, circa 1860. A compact instrument for mountain and military surveying. Used by the Coast and Geodetic Survey. Loaned by: The Smithsonian Institution, Washington, D. C.

22. Theodolite: Made by Troughton & Simms, London, England, circa 1825. Used in locks and canal systems in Lowell, Massachusetts. Loaned by: The Smithsonian Institution, Washington, D. C.

23. Grading Transit-Level: Made by Wm. Wurdemann, Washington, D. C., 1854. Used by the U. S. War Department in the survey of the Washington, D. C., Aqueduct. Loaned by: The Smithsonian Institution, Washington. D. C.

24. Tilting Precise Level: Made by J. Kern, Aarau, Switzerland, circa 1850. Note wooden mounting which encases vial. Used by army engineers in Mississippi River control surveys. Loaned by: The Smithsonian Institution, Washington, D. C.

25. Surveyor's Steel Tape: Manufactured by W. & L. E. Gurley, Troy, N. Y., late 19th century. The length of this tape is 264 feet

(4 chains). Loaned by: The Smithsonian Institution, Washington, D. C.

26. GRAPHOMETER: Made by E. Lutz, Paris, France, 19th century. Late example of the instruments commonly used in the 17th and 18th centuries for ordinary land surveying. (Dimicircle). Loaned by: The Smithsonian Institution, Washington, D. C.

27. THE FIRST TRANSIT MADE IN THE UNITED STATES: Manufactured by Wm. Young & Son, 1831. Loaned by: Keuffel & Esser Co., Hoboken, N. J.

28. K. & E. ENGINEERS EXPEDITION TRANSIT: This transit was salvaged from the K. & E. San Francisco branch store following the San Francisco earthquake and fire, April 15–18, 1906. Loaned by: Keuffel & Esser Co., Hoboken, N. J.

National Geographic Society's New Atlas Maps

With the January 1958 issue of *The National Geographic Magazine* there was issued a map of the Southeastern United States—the first or "No. 1" sheet of a new atlas of the world, planned for distribution, sheet by sheet, with future issues of the magazine. Plans call for seven sheets to be published during 1958.

The sheet size is 25 by 19 inches. The marginless format gives a maximum amount of map for the size of the sheet. No. 1—Southeastern United States—is at a scale of 1:2,851,200 (45 miles to an inch) and has inset maps of the Tampa Bay area, the Hampton Roads area, and the east coast of Florida from Palm Beach to Miami, at scales of 10, 8, and 8 miles to the inch, respectively.

"No. 1" is a multicolor map; shows railroads, main roads, and highways; and has a profusion of place names. Red stars indicate cities which have scheduled air service. Spot elevations are shown in feet, and soundings are in fathoms.

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The Use of the Magnetic Needle on Surveys in Trinidad and Tobago

By PHILIP H. DOUGLIN

LICENSED LAND SURVEYOR, LANDS AND SURVEYS DEPARTMENT,
GOVERNMENT OF TRINIDAD AND TOBAGO, BRITISH WEST INDIES

THE MAGNETIC NEEDLE is used on nearly all second-order surveys in the island of Trinidad, and so, as distinct from most other places, the terms "compass" and secondary surveys are practically synonymous.

Compass surveys in other countries generally refer to surveys of a low order of accuracy executed with the prismatic needle. In Trinidad, however, the instrument used on compass surveys is a 4 to 4½-inch 20″ theodolite or transit to the lower plate of which is attached a trough or tubular needle about 3.3 inches long, capable of being read against an index mark to within one minute of arc. Recently, Messrs. E. R. Watts & Son, Ltd., of England, have been supplying a 20″ instrument on which a shorter tubular needle (about 2.8 inches in length) is attached on the top of the telescope. There is, however, no appreciable difference between results obtained from this type of instrument and the more widely used Cooke, Troughton & Simms 20″ transit with the 3.3-inch tubular needle.

After prolonged and extensive investigation, it has been found that Trinidad is more or less free from local magnetic attraction. Except for a few areas in the Northern Range where traces of iron ore are known to exist and where rocks containing magnetic material (such as basalts and granites) have been found, the needle is used with a far higher standard of accuracy than is generally the case in other countries where sources of magnetic disturbance exist.

Tobago, however, an island ward of the colony has always presented local surveyors with somewhat of a headache. The island is of a volcanic formation, but from a geological point of view, except for the heavy coral limestone deposits in the southwestern end of the island, the composition of the kind of rock found elsewhere is uncertain. Schists similar to those found in the Northern Range of Trinidad are, however, known to exist.

The general configuration, as well as the distribution and structure of the land mass, with a single mountain range, extending as it does longitudinally throughout the center of this island, is believed to have some significant bearing on this peculiar condition relative to the magnetic field. Therefore, until results of the thorough geological and soil surveys soon to be undertaken are known, the definite causes of the magnetic fluctuations now obtaining in Tobago will remain unsolved. Results of magnetic observations made throughout this small island have proved to be erratic, thereby discouraging the general use of the needle.

Manufacturers of theodolites seem to prefer to attach the trough or tube containing the needle to the standards of the upper plate rather than to the lower plate, which has to be raised to give enough clearance above the leveling screws. This latter method of assembly increases to a small extent the instability of the instrument; but the resulting errors, however, are negligible.

The great advantage in having the needle attached to the lower plate lies in the fact that the surveyor can obtain an approximate setting of his instrument within a few seconds when running a line through forested and bushy country. Without disturbing the lower plate to which the needle is attached, he can move the upper plate and sight the trace cutters who can begin clearing the sightways immediately. Meanwhile the needle is settling down, and, after

its oscillations have ceased, the surveyor brings it into exact coincidence with the index mark. Consequently, while the needle is being "set" work is not held up.

The trough compass has been superseded by the tubular needle, the latter being dirtproof and airtight. While the needle can never be made an instrument of very high precision, in districts where there is known to be an absence of local attraction it is capable of producing comparatively good results. In Trinidad for instance the average error of closure of 323 compass traverses run between trigonometric stations about one mile apart is less than 1 in 2,500.

In undulating country covered with dense forests and tangled undergrowth such as is common in Trinidad, where it is only by plenty of cutting that a surveyor may, in good weather, get a solar observation, it is indeed a Godsend for him to be able to orient his instrument within a few minutes of the magnetic meridian. On a survey line, say 6,000 feet long through forested and/or broken country, due to difficulty of view, there are usually not less than 40 setups. This involves 40 independent settings of the needle with a probable error of say $\pm 3'$ of arc at each setting. The wave in the line caused by these independent settings is of a compensating nature and inappreciable for secondary work. In fact, the error at the end of this 6,000-foot line should not be greater than 2.0 feet.

However, in order to obtain satisfactory results, corrections must be made for the following:

1. Magnetic dip
2. Declination of needle
3. Secular variation of the declination
4. Diurnal variation of the declination

The following sources of error must also be avoided:

5. Magnetic storms
6. Local attraction
7. Parallax in reading the end of the needle
8. Eccentricity at point of suspension of the needle

1. *Correction for dip.*—This is really an adjustment to counteract the vertical component of the total intensity of the earth's magnetic field. This correction is usually performed by means of a small movable sleeve-weight sliding on the needle. It is shifted back and forth until the needle lies in the horizontal plane.

Barrow's dip circle is the instrument used primarily for the actual measurement of this function, but the average practicing field surveyor is not too concerned about the extent of this deviation, as this adjustment is usually performed by the manufacturers.

2. *Declination of the needle.*—The declination of the magnetic needle in Port-of-Spain, Trinidad, at the present time (June 1957) is 8° 18′ W. From 1899 up to the present date, this variation has been moving westwards of the meridian at the rate of about 6′ per annum.

A surveyor in Trinidad ordering a theodolite with a tubular needle attached would now require that the central axis of the tube containing the needle should be placed at an angle of 8° 18′ W of the telescope when it points to true magnetic north. On receipt, the instrument is taken to the Savannah Referring Mark in Port-of-Spain, a trigonometrical and magnetic station free from all local attractions. From this point the true azimuth of a certain referring object is known. The surveyor sets on his instrument this known bearing, clamps the upper plate to the lower and then revolves both plates until the referring object is bisected. The needle is then unclamped and the adjustable index at one end of tube, which has a movement of about 1° on each side, is shifted until it coincides with the end of the floating needle. This process is then reversed, the lower plate being unclamped, revolved and brought into orientation by means of the needle, the referring object is then sighted and the vernier read. This reading should be within 2′ of the true bearing. Approximately six independent bearings are taken and the difference between the mean of these and the true bearing of the referring object is called the "error of the instrument."

All compass bearings throughout the island are taken with magnetic needles adjusted to the standard referring mark in

this manner, and a certificate is signed by the surveyor to this effect.

3. *Secular variation of declination.*—By regular monthly checks at the Savannah Referring Mark, Port-of-Spain, corrections for this variation are made. It averages about 6′ per annum. Over the past year I have found this variation to be 6′ greater in a westerly direction.

4. *Diurnal variation of declination.*—In Trinidad this is not more than 3′ at any hour of the day. A table has been prepared from data obtained at the nearest magnetic observatory to Trinidad—Port Vieques in Puerto Rico. It will be noticed from the table below that the most easterly deflection is only about 3′ and the most westerly 2′.

Diurnal Variation of the Magnetic Declination

Hour	Jan.–Feb. Nov.–Dec.	Mar.–Apr. Sept.–Oct.	May–June July–Aug.
7.00 a.m.	+ 0.2′	+ 1.6′	+ 2.8′
8.00 a.m.	+ 0.9′	+ 2.1′	+ 3.1′
9.00 a.m.	+ 1.6′	+ 2.1′	+ 2.3′
10.00 a.m.	+ 1.7′	+ 1.6′	+ 1.2′
11.00 a.m.	+ 1.0′	+ 0.8′	+ 0.2′
Noon	0.0′	− 0.3′	− 0.7′
1.00 p.m.	− 0.7′	− 1.2′	− 1.5′
2.00 p.m.	− 1.2′	− 1.8′	− 1.9′
3.00 p.m.	− 1.2′	− 1.9′	− 2.0′
4.00 p.m.	− 0.9′	− 1.6′	− 1.5′
5.00 p.m.	− 0.5′	− 1.1′	− 1.1′
6.00 p.m.	− 0.1′	− 0.7′	− 0.9′

A plus sign in the above table means a deflection of the north end of the needle toward the east of the average direction for the entire day, and a minus sign a deflection toward the west, so that the above table shows the corrections to be applied to the bearings taken by the compass. It, therefore, follows that opposite signs are to be used for the corrections to the bearings to be put on the instrument when setting out lines.

Examples

1. In the month of June the bearing of a line on a compass reads 45° 30′ at 9:00 a.m. By the above table the diurnal variation at that hour during June is + 2.3′. The correct bearing of the line will therefore be 45° 32.3′.

2. At 3:00 p.m. in January a surveyor wishes to run a line the correct compass bearing of which is 90° 00′ (due east). The diurnal variation by the table is − 1.2′. The reading to be placed on the instrument is therefore 90° 01.2′.

Correct application of the above can be made by remembering the simple mnemonic: "Variation east compass least; Variation west compass best.

5. *Magnetic storms.*—No provisions can be made against this possible source of error. Fortunately, however, in these low latitudes (10°–11½° N), the effect of a magnetic storm on a compass is seldom such as will produce noticeable fluctuations.

6. *Local attractions.*—The existence of this source of error is detected by reading the bearing of a line at both ends. Where local attraction is found to exist, the needle becomes jumpy and unreliable. Astronomical observations for azimuth are taken and theodolite bearings run.

Objects such as steel tapes, chaining pins, axes, etc., made of or containing iron or other magnetic material should also be at safe distances away from the instrument when the needle is being set, and it is needless to say that in built-up urban areas where electric cables carrying current, fences, galvanized iron, etc., are found, compass surveys give place to those controlled by astronomical observations or by bearings obtained direct from the trigonometric framework of the colony.

7. *Parallax in reading the end of the needle.*—With the tubular needle now in use, there is practically no parallax because the end of the needle is observed through a fixed eyepiece which allows the needle to be brought into the closest coincidence with the index mark. In work with the old trough compass, however, it is a frequent source of error.

8. *Eccentricity at the point of suspension.*—The great care now taken in the manufacture of suspensory points and caps on the needles has greatly lessened errors from this source. Unless both ends of a needle are read, there will always be small errors from this cause, but the differences between

independent readings seldom exceed 2 minutes. The pivot is very delicate and the needle should always be locked except when the compass is actually in use on the instrument.

As I have said above, compass bearings throughout the island are obtained with instruments adjusted to the meridian of the Savannah Referring Mark, Port-of-Spain. In order to convert these field compass bearings to grid bearings it is necessary to apply certain corrections for convergence, determined as follows: About forty stations free from all magnetic matter were chosen in various parts of the island. At each station, marked by a concrete pillar, the true bearing of a distant referring object was determined by solar observations and reduced to a grid bearing. These magnetic stations were occupied at different times of the year by observers whose instruments were previously adjusted to the meridian of the Savannah Referring Mark at Port-of-Spain. In each case a series of six independent compass bearings of the referring object was observed. The difference between the mean of these six compass bearings and the grid bearing was adopted as one determination of the required correction.

The following are typical examples of observations taken:

At Port-of-Spain Referring Mark (Morning Observations)—Observed compass bearings to Trinity Cathedral Spire:

	172° 43.2′
	172° 43.2′
	172° 43.5′
	172° 42.5′
	172° 43.0′
	172° 43.0′
$\Sigma =$	1032° 258.4′
Mean observed compass bearing	172° 43.1′
Correction for diurnal variation	+ 1.6′
True observed compass bearing	172° 44.7′
True bearing (azimuth)	172° 43.0′
Error of instrument =	− 1.7′

The following four mean determinations were taken at different times at another station, the compass bearing finally being the mean of twenty-four independent readings.

From Tabaquite Referring Mark: Observed compass bearing to trunk of tree on ridge about six miles away:

Mean of six readings	290° 36.0′
	290° 36.8′
	290° 36.0′
	290° 36.4′
Final mean	290° 36.3′
Grid bearing	290° 31.3′
Correction	− 5.0′

As a result of such observations taken throughout the island at different stations and over a long period, a chart has been prepared showing the corrections to be applied to compass bearings to reduce them to grid bearings. These corrections are derivations of the meridian convergence ($d\lambda \sin\phi$) and the magnetic declination at various places of observation. All points on this chart at which this correction is the same are joined by a smooth almost symmetrical curve resembling an isogonic line.

In Tobago, similar observations have been taken, but the results have been such that a symmetrical chart could not be drawn up. In spite of the fact, therefore, that the Land Surveyors Ordinance 1952 provides for the use of the needle in Tobago, surveyors are very reluctant to rely on needle determinations in that island. Fortunately, there is in existence a strong network of triangulation in this island due to the build and general terrain. Orientation for ordinary survey work in Tobago is based primarily on azimuths obtained from solar observations and from grid bearings calculated from rectangular coordinates of two intervisible trigonometric stations.

There are probably other places which, if examined, will be found like Trinidad to be practically free from local attraction. In these circumstances greater use can be made of the magnetic needle on surveys of second-order precision, especially where such work has to be executed in forested areas.

The Use of Type in Cartography

By JOHN S. KEATES

ESSELTE AKTIEBOLAG, GENERALSTABENS LITOGRAFISKA ANSTALT, STOCKHOLM

DESPITE the great development in the use of typeset names on maps, and the attention given to methods of type composition and stickup, relatively little interest has been shown by cartographers in the actual selection and control of suitable type faces. On their part, professional typographers, schooled in the requirements of normal book and display work, do not seem to have contributed very much to the special problems of type on maps. In general, this aspect of cartographic design has been neglected, which is strange when one remembers the acrimonious arguments about the beauty of hand-lettering as opposed to type.

Perhaps one of the strong cards of the hand-lettering school was that hand-lettering was generally carried out by expert craftsmen, competent within their stylistic limits. But very often the selection and arrangement of type is entrusted to editors or draftsmen with little knowledge of the difficulties and possibilities of this exacting medium. Even though most cartographic organizations do not have the resources to overcome all the difficulties, at least the problems should be fully explored and evaluated.

The basic material available to most cartographers is, of course, type designed for bookwork. This is itself a major problem in that the requirements for text reading are normally quite different from those for map reading. A person reading printed text in his own language does not read individual letters: his eye responds to certain shapes, and as long as these can be readily picked out he experiences no difficulty. Consequently, the arrangement of space between letters, words, and lines is as much a part of design as the appearance of the type itself.

Spacing and leading are a major concern for the book typographer and much of his time is devoted to this problem.

These basic elements in the design of type for books are not present in maps. Individual names are frequently unfamiliar to the user, and often in foreign languages or transliterations. Consequently, the legibility of individual letters is of far greater importance, especially in the small sizes. An otherwise attractive type face is reduced in value if there is a possibility of confusion between c and e, or i and j. In addition, the pattern of arrangement is irregular, names may be curved and aligned away from the horizontal, and are frequently placed over other lines and colors.

Another aspect of contrast is in the purpose of the type itself. In maps the actual style of the face, serif or sans serif, roman or italic, conveys a secondary meaning of classifications. Therefore, the tenet of book typography—don't mix type faces—cannot apply to cartography, where this procedure is desirable if not unavoidable. The use of capitals and italics within one face will give four variations, but this is rarely enough for a map. Generally, the contrast between serif and sans serif is employed, and most maps are constructed using one from each of those groups of faces.

When selecting a type face for a particular classification, the characteristics should be carefully scrutinized. Types vary considerably in size on the body, length of ascenders and descenders, width (set), style of italics, shading of verticals (in serif faces) and general weight in appearance. Where many names must be legible at a small size, a face which is large on the body but not too wide set is preferable. Where capitals in larger sizes are numerous, the individual style and balance of the letters become more important. For example, among the serif faces, *Times, Plantin,* and *Imprint* are excellent in small sizes of lowercase, all being large on the body (*Times* is the largest of all faces) and fairly heavy. *Bembo* and *Perpetua* at six point are relatively poor, but

their capitals in larger sizes can be effectively used. Sometimes the smaller and lighter faces are valuable for naming minor features unobtrusively.

As an aid to selection, the following points may be kept in mind.

Medium and heavy faces large on the body show best in small sizes on strong backgrounds.

The effect of spacing brings out difficult letters, such as the dropped J in *Baskerville* and *Garamond.*

Italic caps with varying slopes merely look irregular when spaced out, e.g., *Garamond.*

Decorated letters look out of place on a map, e.g., italic J in *Plantin* and italic Q in *Garamond.*

Modern numerals (such as *Times* and *Bodoni*) are preferable to ranged figures, as in *Perpetua.*

Letters with pronounced vertical shading, such as *Bodoni,* are generally more difficult to read in small lowercase than those with rounded shading.

Points of confusion should be watched, e.g., i and j in *Spartan,* italic b and h in *Garamond,* italic u and v in *Baskerville.*

Italic capitals with only a slight slope do not help to make distinct classification, e.g., *Perpetua.*

Bold sans serif faces are usually ugly.

Condensed capitals are useful where emphasis is required in a limited space.

Decorative faces, such as *Lydian,* are most successful in spaced capitals.

When ordering type from a printer, one aspect most neglected is close attention to spacing. Considerations of space and cost often preclude this refinement, but capitals and large lowercase should always have some letter spacing. In this I am not thinking of names set wide to a given measurement of ems, but names which are frequently set solid when they could be vastly improved by slight interletter spacing of one or two points. In good bookwork small capitals are always slightly spaced, and this is a rule worthy of attention. Even if it means going down one point size, the improvement in legibility and appearance is worth it. Small names aligned diagonally or pulled into curves (such as river names) also benefit considerably by slight spacing.

From the foregoing it is fairly clear that ideal type faces are not commercially available to most cartographers. (I exclude organizations rich enough to design and cut their own types.)

For an ideal face I would list the following points:

1. Large in the body, fairly narrow set, short ascenders and descenders, good open counters.
2. Rounded shading (in serif style) with not too much contrast between thick and thin strokes.
3. Plain italics, without any fancy letters.
4. All capitals to range on the same base line.
5. A semibold version for use where emphasis is required.
6. A related sans serif face to match.
7. A condensed version in all sizes above 10 point.
8. A decorative style of caps to match.

Is there any possibility that some imaginative typographic designer could take this up with one of the great typographic organizations?

₹ ₹ ₹

Tract Map Business

The International Blue Printer, February 1958, pages 30–31 and 62, carries an article about a blueprinting concern in Los Angeles that makes the selling of city and county maps, including tract maps, a major part of their business. This company—McWain Blueprint Company—located in downtown Los Angeles, close to city, county and state highway offices, buys some negatives and tract maps and borrows the originals of others to make up their file of negatives.

Their collection, started in 1933, now includes some 20,000 negatives of tract maps. The present owners of the company, A. W. Cazares and H. J. Comers, state that, of the 40,000 maps sent out each year 25,000 are tract maps.

Customers are mainly surveyors, engineers,

(Continued on p. 78)

Surveying by Imagination

By J. BURRUSS SMITH

The following story appeared in the May–June 1957 issue of *Field Notes*, the official publication of the Georgia Association of Registered Land Surveyors, under the title of "A True Story Told." It is reprinted here with permission of the author and of the Association.

—EDITOR

AFTER DISCUSSING with a member of the Georgia Association of Registered Land Surveyors, a few of the experiences I have had in my thirty years of surveying, the member has requested more than once that I disclose some of them in *Field Notes*, so here goes with one of them.

Some fifteen or twenty years ago I was called to make a survey and plat of fractional lot number 269 in the Ninth District in Pike County, Georgia, belonging at the time to J. E. Johnson. It had been owned by Mr. Johnson's father, who had lived to be about 75 years of age. The property owner had in his possession a plat made by the State surveyors and dated September 1821. The plat showed an area of 152 acres, three roods, and 36 poles, with Flint River as the western boundary and straight lines as boundaries on the north, east, and south, forming a figure similar to that shown in figure 1.

A copy of this plat is a matter of record in the office of the Secretary of State, or Department of Archives and History, in Atlanta. I am in doubt as to the stated length of the south line.

According to my findings the river was up several feet the day this survey was made. This is proven by the fact that, beginning at a plain hedgerow on the east side near the northeast corner and measuring west along a plain hedgerow across the north side, 18 chains goes to the foot of a hill; it is 22½ chains to the river bank.

This statement is further proven by the fact that the branch (to be as shown, crossing the east line and entering the river near where the south line of the lot strikes the east bank of the river) must flow up and over a high hill, indicating that the branch was drawn purely on the surveyor's imagination.

After the branch crossed the east line, my imagination is that the surveyor, knowing how the river ran as it passed the south line, and knowing also how it approached

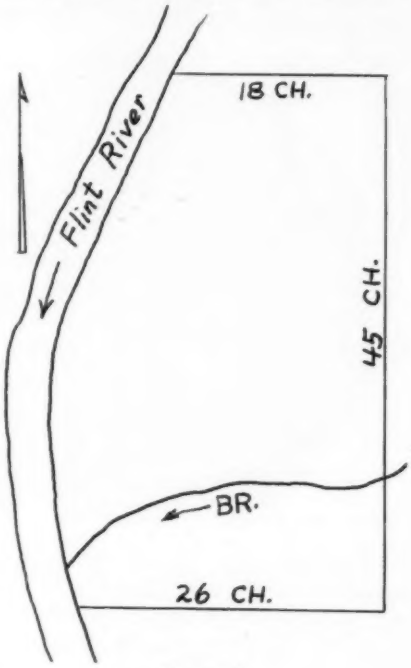

FIGURE 1.

the north line, thought it had to run as it was drawn. (The land east of the river is very step as the south line approaches the river, therefore the above-normal flow would make very little difference in the length of the south line). Further proof of the State surveyor's imagination is the fact that, as drawn, the river would run up and over the same hill previously mentioned and through what is now a cemetery, probably 100 feet

above the water surface in the river. While imagining his survey to be mapped, he conveniently imagined the area to a pretty fine fraction of an acre in order to fool his boss. The river bank was never traverssed.

At the time of the original survey the land was very nearly completely covered with tall trees, making it impossible for the surveyor to see a hill unless he was on it, therefore the State surveyor did not know of the existence of a hill in the position mapped as the river bed.

Figure 2 represents my findings. Considering this sketch, it will be noted that the

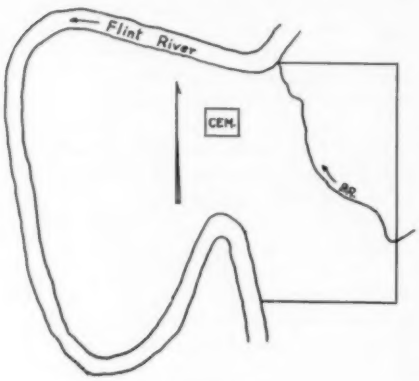

FIGURE 2.

branch runs into the river where the north line of the lot strikes the river. The river, being above normal, covered the branch and branch bottom land, making it impossible for a man at the foot of a hill to tell which way the river ran. [In the course of recent correspondence with Mr. Smith, we learned that he found the actual area of the tract to be more than 280 acres—nearly twice the area shown on the original plat.—EDITOR]

The State surveyor made a pretty good looking plat, and he got by for the time being, just as some so-called "surveyors" do today.

An error in a survey may be overlooked for a while but you can't take the land with you, and if you don't take it with you some surveyor that knows his job is sure to find it and be cursing "that jackass" that made the survey, before your sons, grandsons, and great grandsons, maybe 100 years after you are dead. Let's save our descendants that embarrassment and do our work so they can be proud of us.

Mr. Johnson says his father told him he always heard the party of surveyors had a barrel of peach brandy when they were surveying near what later became his place; that they all got drunk, lost their chain, and cut a grape vine and used it to finish the job.

I have found greater errors than this, and it is not often we find two lots the same size although the official records say they are all the same size. It is very seldom I find a corner that has any markings other than the intersection of two hedgerows several feet wide. Until we get each tract accurately surveyed and mapped and marked with permanent markers, and all tracts tied together in records and maps, this country just has not yet been surveyed so far as the lot lines are concerned. It has just been surveyed at. If we want accurate and definite information, where can we get it?

(Continued from 76)

construction companies, and real estate agencies. Lumber companies and others interested in likely contracting activity also make use of this service.

Appraisers use tract maps for information on value of adjoining properties and zoning involved. Industrial companies, motion picture companies, and various private and local government engineers from nearby cities, towns, and places outside the county also use these maps.

Only one other company—Southern California Blueprint Company—has, according to Mr. Comers, attempted to set up a similar service.

It is simpler and more convenient for others to get maps from this service than to assemble a collection of negatives. Only Los Angeles County has a larger file than that available at the offices of the McWain Blueprint Company.

LINE WEIGHT PROBLEMS

IN MAP REPRODUCTION??

KLIMSCH VARIOMAT Line Variator

(U.S. Patent No. 2,776,595)

Lensboard accessory adaptable to almost any type horizontal reproduction camera

Manufactured by:

KLIMSCH & CO., FRANKFURT-MAIN, WEST GERMANY

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Prism Device for Laying Out Curves

By SERGE A. EMERY

PROFESSIONAL ENGINEER AND LAND SURVEYOR

A NEW ADAPTATION of the right-angle prism called the "Curvigraph" has been developed in Switzerland. (Fig. 1.) Although perpendiculars may be set out with the Curvigraph, it is designed primarily for use by one man in establishing or checking points on a circular curve, with no field computations required.

FIGURE 1.

This device has a regulating screw that moves the lower of two prisms inside the instrument to permit observing any required angle. As it is light in weight—less than 6 ounces—it may be hand held, with a plumb bob, or it may be mounted on a metal foot. The Curvigraph is suitable for use in fairly flat terrain having differences in elevation of not more than four or five feet. It should not be used where the length of chord exceeds 200 or 250 feet.

To illustrate the use of the Curvigraph, suppose that two tangents *AB* and *DE* (*See* Fig. 2) are to be connected by a curve. Four equally-spaced points, C_1, C_2, C_3, and C_4, are to be staked out on the curve. Angles *ABD*, BC_1D, BC_2D, BC_3D, BC_4D, and *BDE* are all equal. The Curvigraph is held at *B* and sighted in the upper prism at a range pole placed on the line *AB*. If the regulating screw is adjusted to bring the image in the lower prism of a range pole placed at *D* in line one above the other with the image of the first range pole, the correct angle is set in the instrument. The range pole which was at *A* is now placed at *B*, and the Curvigraph is taken to the approximate location of C_1, (C^1 or C^2).

By moving toward or away from the center of the curve (approximately along the radius and without changing the prism adjustment) a point will be found where the two range-pole images are again lined up one above the other. This point is on the curve and is staked as C_1. The same procedure is followed to determine the other required points.

If points *B* and *D* are not intervisible, or if the distance *BD* exceeds 200 or 250 feet, one or more points must be set on the curve by conventional methods with a transit so that these limitations will not be exceeded.

Additional information about the Curvigraph may be obtained from the author, 41 Shonnard Avenue, Freeport, N. Y.

This device is not a precision instrument; its use is limited to comparatively short distances in flat terrain; and it cannot be used on spiral curves. However, it may be a welcome addition to a surveyor's equipment, to be used where precision is not required. For example: in laying out curved driveways or walks on an estate or in small parks. —EDITOR

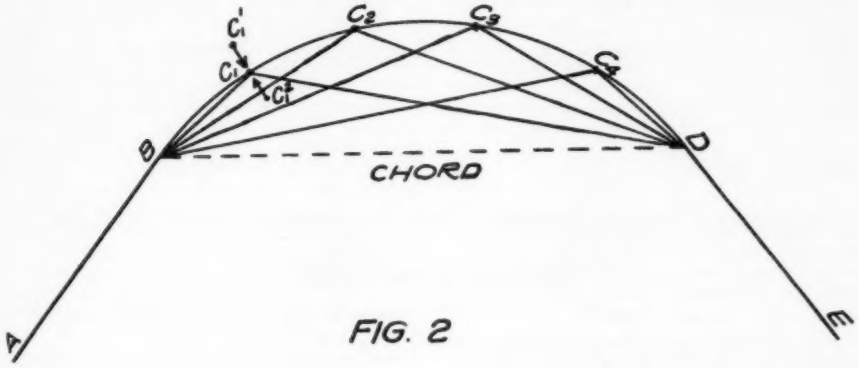

FIG. 2

Trough Discovered in the Gulf of Alaska

Discovery of an extensive trough in the floor of the Gulf of Alaska has just been announced by the Coast and Geodetic Survey. Survey ships operating in Alaskan waters have confirmed the existence of this extensive depression in an area particularly significant as potential spawning grounds of devastating seismic sea waves that rush southward over the Pacific.

The information has been pieced together by hydrographers at the Survey's Washington office from the data obtained by the survey ships as they crisscrossed the Gulf of Alaska in going to and from the working grounds in the Bering Sea and Aleutian Islands. The existence of the trough has been suspected for many years from the scattered depths that have been recorded in the area. Until additional data were received from the 1957 season's work, the lines of soundings had been too far apart to recognize the separate depressions as part of one continuous trough.

The trough is located in the Gulf of Alaska and lies parallel to the Aleutian Trench at a distance of 60 miles to the east. The slightly curving depression is known to be at least 250, and possibly 400, miles long. The bottom of the trough lies 500 to 700 feet below the sea floor which varies in depth between 9,000 and 13,000 feet. It is estimated to be about 2 to 3 miles wide throughout most of its length. There are indications that the trough continues in a southwesterly direction before joining the deeper Aleutian Trench.

U.S.G.S. Status Maps

The United States Geological Survey has issued new (January 1958) status maps as follows:

Status of Topographic Mapping "shows topographic and planimetric quadrangle maps, produced by the Geological Survey and other Federal Agencies, and published at various scales ranging from 1:24,000 to 1:250,000." The classifications are (1) Modern maps, (2) Maps in need of revision, (3) Maps of limited usefulness, (4) Maps in need of resurvey, (5) Planimetric maps, and (6) Work in progress—new mapping, remapping, and revision.

Status of Aerial Photography "shows all areas known to have been photographed by or for Federal, State, and Commercial Agencies." The classifications showing "agency holding primary photography" are Commodity Stabilization Service, Soil Conservation Service, Forest Service, Geological Survey, Corps of Engineers, United States Air Force, Coast and Geodetic Survey, and States and Commercial.

Both map sheets are 26¾ × 40¾ inches and are available from the Map Information Office, Geological Survey, Department of the Interior, Washington 25, D. C.

Surveying and Mapping News

Members are requested to send in surveying and mapping news items for publication in SURVEYING AND MAPPING.—EDITOR.

CURRENT SURVEYING AND MAPPING LITERATURE

MAGAZINE ARTICLES

General Interest

THE EIGHTH INTERNATIONAL CONGRESS OF PHOTOGRAMMETRY. George D. Whitmore, *Revista Cartografica,* Instituto Panamericano de Geografia e Historia, Comision de Cartografia, Buenos Aires. Ano 5, No. 5, 1956. (Comprehensive report on the 1956 meeting at Stockholm.)

WILLIAM SCORESBY: YORKSHIRE PARSON AND ARCTIC ADVENTURER. Leslie Gardiner. *The Nautical Magazine* (London), March 1957. (Brief account of the career of a noted explorer.)

VARIATION. Commander K. F. Boxall. *The Nautical Magazine* (London), Vol. 177, No. 6, June 1957. (An amusing "composite true story" of shore triangulation by ships' officers.)

THE ROLE OF THE CIVIL ENGINEER. Symposium. *Journal of the Washington Academy of Sciences,* Vol. 47, No. 7, July 1957. (Entire issue devoted to a symposium of ten articles by various authors on different phases of engineering, including the role of the civil engineer in surveying and mapping.)

COMPUTERS ARE READY TO ROLL. (No author given.) *Engineering News-Record,* Vol. 159, No. 13, September 26, 1957. (Report of an engineering productivity conference held in Boston with the use of electronic computers and photogrammetry among the leading subjects for discussion.)

Cartography

PLASTIC MATERIALS—THEIR USE FOR MAPMAKING IN HOLLAND AND GERMANY. P. A. van Gorsel. *The Chartered Surveyor; the Journal of the Royal Institution of Chartered Surveyors,* Vol. 88, No. 4, October 1955.

THE QUICK-ETCH PROCESS, CONVERTING ENGRAVED COATED VINYLITE SHEETS OF POSITIVES. Aeronautical Chart and Information Center, St. Louis. *Revista Cartografica,* Buenos Aires, Ano 5, No. 5, 1956. (Illustrated discussion of the results of experiments conducted in the conversion of engraved coated vinylite sheets from negative to positive form.)

PHOTO-MECHANICAL VIGNETTING. Aeronautical Chart and Information Center, St. Louis. *Revista Cartografica,* Buenos Aires, Ano 5, No. 5, 1956. (Details method of producing vignette bands for application to charts.)

JET NAVIGATION CHARTS, SCALE 1: 2,000,000. U. S. Air Force Aeronautical Chart and Information Center. *Revista Cartografica,* Buenos Aires, Ano 5, No. 5, 1956. (Review of the development of the modern jet navigation chart.)

CARTOGRAPHY AT UNITED NATIONS HEADQUARTERS. Norman L. G. Williams. *Cartography* Australian Institute of Cartographers, 55 Collins Place, Melbourne), Vol. 2, No. 1, March 1957. (Describes organization and administration.)

MAP PROJECTION BY TRANSFORMATION. William J. Sear. *Cartography,* (Australia), Vol. 2, No. 1, March 1957. (General discussion of construction and interrelationship of various forms of map projections.)

ANTARCTIC CARTOGRAPHY. Phillip Law. *Cartography,* (Australia), Vol. 2, No. 1, March 1957. (Discusses background and recent developments.)

ANTARCTICA; 1: 10,000,000 ZENITHAL EQUIDISTANT PROJECTION. (No author given.) *Cartography,* (Australia.) Vol. 2, No. 1, March 1957. (Describes construction of new map series.)

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—Lyman D. Lynn

Coast and Geodetic Survey

DISTINCTIVE RECENT MAPS

A map of *North America*, showing generalized relief with contours and color gradients, was published in 1957 by John Bartholomew & Son, Ltd., Edinburgh. It is at the scale of 1:10,000,000 and is on the Chamberlin Trimetric Projection. Two classes of roads and railroads, international and internal boundaries, and major cities are indicated. The map sheet measures 38 by 28 inches.

Two resource maps of Yukon Territory were recently published by the Geographical Branch, [Canadian] Department of Mines and Technical Surveys. *Yukon Territory Transportation and Resource Development 1955* shows two classes of roads, railways, water routes, territorial boundaries, and mining and fur trapping centers.

The same data, estimated for future decades, is presented on *Yukon Territory Transportation and Resource Development Projected to 1970–1980*. Both maps measure 19 by 13 inches and are at the approximate scale of 1:3,200,000.

Linweave Paper Company, Springfield, Mass., copyrighted in 1957 a colorful and attractive *Map of the United States at the Close of the Revolutionary War*. It is the first of a series of four maps which Linweave will issue showing the territorial expansion of the United States. The map, drawn by Karl Smith, includes notes of historical events, some of which are illustrated with pictorial sketches. A legend gives "Important Historical Data Not Shown on the Map." The scale is approximately 1:11,000,000 and the size is 15 by 20 inches.

A Map of Colleges and Universities in the United States was prepared by General Drafting Company, Convent Station, New Jersey. It was presented, by Esso Standard Oil Company, to the American Association of University Women on the occasion of their seventy-fifth anniversary. It consists of two maps, one on either side of the map sheet which folds to pocket size. *Western United States Colleges and Universities*, locates institutions in the States west of the Mississippi River. *Eastern United States Colleges and Universities* gives the distribution of schools east of this division line. Both maps are supplemented by indexes listing the institutions by States.

A map showing distribution of *Population, Towns and Cities*, Washington: April 1, 1957, was published in September 1957 by the Washington State Census Board, Seattle. It was compiled under the direction of Calvin F. Schmid, and the statistical data are overprinted on a physical map prepared by John C. Sherman and Willis R. Heath of the Cartographic Laboratory, University of Washington. Symbols used on the map are three-dimensional. The number of people represented by each symbol is proportional to its volume. The map measures 19½ by 33 inches. No scale is given.

Map of the Indian Country in Arizona, New Mexico, Utah & Colorado is a cartographic invitation to motorists to visit this interesting and scenic region. Designed to fit in a pocket or glove compartment, the map carries on the verso a lengthy index of place names keyed to locations on the map. This side also includes brief hints for desert driving and a small map of "Hopi Indian Villages." The main map measures 20 by 28 inches (unfolded) and is at the scale of 1:820,500.

The "Indian Country" map was published in 1957 by the Automobile Club of Southern California, Los Angeles. It is available only to club members and to members of AAA clubs on personal request at one of the Club's district offices located in the principal cities of southern California.

The Bureau of Land Management, U. S. Department of Interior published in 1957 a new map of the *State of Colorado* at the scale of 1:750,000. In addition to county boundaries, county seats, and other cities and towns, the map shows private land grants, national forests, Indian and military reservations, national parks, monuments and game reserves, U. S. and State Highways, and parts of the public domain which are "vacant" and "withdrawn." The map, which measures 28½ by 33½ inches, was compiled by R. W. Schlitt from the official records of the Bureau of Land Management and other sources.

A large (40 by 47 inches), colorful *Wyoming Soils Map* is a cooperative publication of the University of Wyoming Agricultural Experiment Station and the U. S. Soil Conservation Service. The map, published in 1957 at the scale of 1:500,000, was issued in conjunction with Bulletin 349, "Wyoming Soils and Soil Materials," prepared by T. J. Dunnewald. Colorful symbols identify seven major soil groups. The soil distributions are superimposed on the "Uncolored Geologic Map of Wyoming" issued in 1952. The underlying geology is indicated by letter symbols.

The Arkansas State Highway Commission and the U. S. Department of Commerce's Bureau of Public Roads have cooperated in compiling and publishing two highway maps. *Traffic Volumes Map 1956 Traffic, State Highway System State of Arkansas* is a blueline print measuring 17½ by 19½ inches. Figures along the roads show 24-hour annual average traffic. The year 1956 showed a statewide average increase of 4 per cent over 1955. *Traffic Flow Map 1956 Traffic State Highway System State of Arkansas* is a three-color map 11 by 13 inches in size. Twenty-four hour annual average traffic is indicated along main routes by varying bands of blue. Both maps were drawn by W. H. Moore.

The Maine Geological Survey (Augusta) has introduced a new series of reference maps to the

mineral resources of the State. The maps are planned as reference sources "in locating mineral occurrences in Maine and literature which describes such occurrences." The *Bangor Sheet*, scale 1:250,000, is the first to be published (June 1957). "Each symbol printed in red on the map is accompanied by a numeral-letter key which refers to the locality list" printed on the verso of the map sheet. This list in turn indicates the names of authors whose published material is listed in the bibliography, also printed on the verso.

New maps of several Latin American countries have been received. *Mapa Oficial de la Republica de El Salvador* is a large (40 by 60 inches) physical-political map. It was published in December 1956 by Dirrección General de Cartografía, Ministerio de Obras Publicas, Republica de El Salvador. Generalized relief is shown, on this 1:200,000 scale map, by hypsometric tints. Administrative boundaries, settlements, and several classes of road are also shown.

Instituto Geografico de Costa Rica (San Jose, Costa Rica) published in May 1956 the *Mapa Politico de Costa Rica* at the scale of 1:1,000,000. Roads, railroads, and populated places are indicated in addition to administrative boundaries. The map measures approximately 16 by 20 inches.

Mapa Ferroviario del Peru Año 1957, shows railroads and administrative boundaries. It was published at the scale of 1:3,000,000 by the Peruvian Dirrección General de Ferrocarriles, Ministerio de Fomento. Measurements of the map are 30 by 21 inches.

Physiographic Diagram Atlantic Ocean presents, by means of perspective sketching, the submarine topography of that ocean basin. It is at the scale of 1:6,000,000 and measures 55 by 28 inches. The map, which was prepared by Bruce C. Heezen and Marie Tharp, is reprinted by permission of the Lamont Geological Observatory (Columbia University).

Several interesting and informative maps have recently been received from Generalstabens Litografiska Anstalt, Stockholm, Sweden. *Automobilkarta över Sverige*, portrays the highway network of Sweden at the scale of 1:2,000,000. The map measures 32 by 16 inches.

The same information is shown in greater detail for the southern part of the country on *Motormännens Vägkarta över Sverige*, which is at the scale of 1:1,000,000 and measures 28 by 26 inches. There are enlarged insets (1:600,000) for Stockholm and vicinity and for the southern extremity of Sweden.

Skärgarden Landsort-Stockholm-Örskar presents the picturesque, irregular, and island-fringed coastline of eastern Sweden, extending from just south of Stockholm northward beyond Öregrund. It measures 37½ by 14½ inches and is at the scale of 1:200,000. Roads, railroads, communication systems, towns and cities, and various tourist attractions are mapped.

Afrique du Sud, Carte Economique, is a cartographic presentation of the distribution of economic resources of South Africa. Pictorial and color symbols locate the principal agricultural regions and products, mineral deposits, and industrial centers. The map, printed by l'Institut Geographique Nationale (Paris) in 1956, is number 76 in the series issued by the Direction de la Documentation, Secretariat General du Gouvernement (France). The scale is 1:5,000,000 and the dimensions 24 × 30 inches.

Some of the grandeur of Africa's *Mount Kenya* is strikingly portrayed on a large scale (1:25,000) map published in 1957 by Great Britain's Directorate of Overseas Surveys, Kingston Road, Tolworth Surbiton, Surrey. The relief portrayal, a combination of contours, color, and shading, is designed to emphasize both the deeply dissected glaciated valleys and corries, as well as the steep, crowning central peaks. Surveys for the map were completed in 1953 and are described in the October 1954 issue of the *Empire Survey Review*. The map, which measures 31 by 31 inches, is presented as an experiment, and is accompanied by a descriptive summary. The Director of Overseas Surveys is interested in receiving suggestions and constructive criticisms concerning the map.

The Federal Survey Department, Lagos, has published in 1957, two interesting maps of Nigeria. *Population Map of Nigeria 1952–53 Census*, shows density of population per square mile by color designations. Administrative subdivisions of the country are delimited and named. The map scale is about 1:3,000,000 and the measurements are 15½ by 18½ inches.

Nigeria 1: 2,000,000 Coverage of Aerial Photography shows areas for which aerial photographic coverage is available. Photographing agency and scale of coverage are given. Additional information concerning the photography of Nigeria may be obtained on application to the Director of Federal Surveys, Survey Department, Lagos, Nigeria.

A *Road Map of the Hashemite Kingdom of Jordan* is a 1956 publication of the Jordan Department of Lands and Surveys. It is at the scale of 1:750,000 and is on a topographic map base. Three classes of roads, tracks, railroads, internal and international boundaries, towns and villages, and wadis and mud flats are shown. In the right margin of the map sheet there is a list of places, keyed to names on the map. Names are given in Arabic and English. Antiquity sites are identified by red dots. The map sheet measures 28½ by 23 inches.

The Department of Lands and Surveys has also published a three-sheet *Geological Map of Jordan (East of the Rift Valley)*, 1954–1956. At the scale of 1:250,000, each sheet measures 33 by 25

inches. The map was compiled under the direction of A. M. Quennell, formerly Assistant Director, Department of Lands and Surveys, "with acknowledgment to G. S. Blake, S. H. Shaw, D. J. Burdon & others." Formations ranging in age from PreCambrian to Miocene are mapped. Structural geology is also shown by appropriate geological symbols.

The Surveyor General of India issued in 1956 a new edition of the *Railway Map of India* at the scale of 1:4,250,000. Operating railroads, of several gauges, as well as those sanctioned or under construction are shown, and State boundaries are indicated. Measurements of the map are 34 by 39 inches.

The southwest sheet of a projected four-sheet map of *Soviet Central Asia and Kazakhstan* was published late in 1957 by the Central Asian Review of London. The three remaining sheets should be ready in 1958. Orders may be placed with Messrs. Luzac and Co., Ltd., 46 Great Russell Street, London, W.C.1. The map, at the scale of 1:3,750,000, is in six colors and portrays relief by means of contours. Roads, railroads, administrative boundaries, ruins of ancient cities, and old earthworks are among the cultural features mapped. The Central Asia map is modified from a Russian map, at the scale of 1:5,000,000, published in the *Atlas Mira* of 1954. As far as possible, revisions have been made to 1957. All place names are translated according to systems approved by the Permanent Committee on Geographical Names for British Official Use.

The Mapping Branch, Department of Lands and Surveys, Perth, Australia, has issued a *Road Map of Western Australia.* The map sheet includes two maps, one of all of western Australia, at the scale of 1:3,000,000, and a second of the southwest section of the area, at the enlarged scale of approximately 1:1,500,000. Both maps show highways, "other roads," and railways. The sheet measures 27½ by 37 inches.

A *Land Use Map of Sarawak and Brunei,* in seven sheets, at the scale of 1:250,000, is a 1957 publication of the Land and Survey Department, Sarawak. Utilization categories, indicated by appropriate color symbols, are (1) Settled Cultivation, (2) Shifting Cultivation, (3) Mangrove and Nipak, (4) Kerangas Forest, (5) Alan Forest, (6) Padang Paya Forest, and (7) Other Forest. Several classes of roads, railroads, administrative boundaries, airports, oil fields, and communication lines are also shown. Each sheet measures approximateiy 45 by 30 inches.

—WALTER W. RISTOW
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The Surveyor and the Law

What Data Does the Attorney Desire to Receive from the Surveyor?

By VERNON ELLEDGE

ATTORNEY AT LAW

My subject involves the question of what information the attorney needs the surveyor to provide. Of course it would be simple to say that the attorney desires the surveyor to locate all of the original monuments and bearing trees, but finding all of the original monuments and bearing trees is about as rare as finding a perfect record title, and a perfect record title is as rare as the wild pigeon.

The first thing the attorney likes to see is full information as to what the surveyor finds on the ground. Survey maps vary greatly in the amount of information supplied by the plat. The simplest and least informative is that supplied by surveyors who survey city lots for mortgage companies, where the surveyor usually does not show any stakes or reference points at all. The most elaborate and satisfactory that I have seen are those prepared by the Survey Department of Shell Oil Company, where all data observable upon the ground are shown on the plat with the greatest detail and accuracy.

Specifically, I like the surveyor to distinguish between the monuments and bearing trees he found on the ground and the monuments he set and the bearing trees he marked, and to indicate the apparent age of the various monuments and bearing trees which he found.

Referring first to those monuments which the surveyor sets, I am happy to see the increasing use of monuments which show the identity of the surveyor and the date the monument was set. We have for too long followed the practice of having surveyors use an unmarked pipe for a corner, and then having subsequent surveyors guess at who set that particular pipe and when it was set. I feel that every monument, rod, or pipe set by a surveyor should be identified in some manner with his initials or symbol and the date, so that subsequent surveyors may identify it as his monument. Incidentally, surveyors have their own ways of identifying the marks of previous surveyors. I knew of one surveyor who was very tall, and his three hacks on sideline trees appeared considerably higher on the tree than the three sideline hacks of other surveyors in that neck of the woods, so that every surveyor in that country could tell when a particular line had been marked by that unusually tall surveyor.

Referring now to monuments found on the ground by the surveyor, those of us who examine survey plats consider it to be of the highest importance that every single concrete monument, pipe, iron rod, or other marker which is visible on the ground be recorded by the surveyor and shown on his plat, whether it means anything to him or not, and whether it is directly on the line or not. Every such marker should be tied in and shown on the plat, because even though it does not mean anything to the surveyor, it may mean a great deal to the attorney when he examines four, five, six, or a dozen sets of field notes appearing in the abstract as to this and surrounding surveys.

Moreover, I think it is essential that the surveyor tie in and show on the plat every single fence, old fenceline, hedgerow, stream, bearing tree, and marked line. I recall one lawsuit which we won because we found an old fore-and-aft tree and an old hedgerow to mark the location of the original line as being where we contended it was, some 60 feet west of the new line and fence. The abstract on that particular tract was an interesting demonstration of the fact that many notaries public who draw deeds feel that a set of field notes is sacrosanct and must be copied as it is. The earliest deed contained a satisfactory set of field notes, but in the next deed the copyist left out one call, that mistake was religiously copied in half a dozen subsequent deeds. Then some other copyist left out another call, and both of those mistakes,

Presented at the Twenty-fifth Meeting of the Texas Section ACSM, March 29, 1957.

along with several others, were continued on down through the next ten or fifteen deeds, so that for the past thirty or forty years the field notes used in the deeds simply ran north 400 varas and came back south 250 varas, which is not what I call a very satisfactory description of a tract of land.

It is absolutely necessary that the location of fences be shown. There is no other way for the examining attorney to determine whether there has been an encroachment on some other land by the owner of this tract or an encroachment on this tract by some other owner. Of course it is always to be hoped that the encroachment is in favor of the owner of this tract and is upon and against the adjoining tract and the adjoining owner, but this is not always true. If in fact the encroachment is in favor of the owner of this tract, and his fence encroaches upon some other tract, and if the oil and gas lease the attorney is examining has a Mother Hubbard clause,* it is true that the Mother Hubbard clause will cover any small strips of land which have been acquired by limitation title. This was reaffirmed in the very recent case of Allison v. Smith, by the Texas Supreme Court, not yet reported. It is interesting to observe that in that case, under the particular facts there in evidence, the Texas Supreme Court held that the Mother Hubbard clause did not convey any interest in an additional quarter section which was not described in the particular description. The concurring opinion said that the Mother Hubbard clause is only for the purpose of conveying small strips of land which are normally considered to be a part of the main tract described in the particular description. Nevertheless, as to encroachments by the owner of this land made upon adjoining land, even though the Mother Hubbard clause covers and conveys them, it is always desirable to know about them, and where possible to go out and obtain quitclaim deeds or boundary-line agreements, so as to remove all doubt as to the ownership of the strips as to which the encroachment exists.

* A clause often used in oil and gas leases which provides that the instrument covers not only the specifically described property but also any land owned or claimed by the lessor and which adjoins the land specifically described. Its purpose is to pick up strips to which the lessor has acquired limitation title and to correct minor errors in description.—Southwestern Legal Foundation, Second Annual Institute on Oil and Gas Law and Taxation, p. 83.

Having said that the attorney would like the surveyor to tie in and show on his plat all monuments, streams, fences, marked trees, and marked lines (incidentally, I have seen in many early surveys where the surveyor noted that he crossed the Cherokee Trace, so if any of you should cross a Cherokee Trace at any time, I hope you will show it on your plat) may I say further, that I am assuming you will be able to bill your client for the additional time which I know that it takes to prepare so detailed and painstaking a plat.

I turn now to the question of navigable streams. This is a very important question in all surveying in Texas, and I assume that it is in other States. It is important that the attorney be advised as to whether or not there are any navigable streams crossing or bordering the tract under examination. You know, of course, that any stream having a width of thirty feet from the mouth up is navigable, but I will not stop here to discuss the meaning of the phrase "from the mouth up" nor to attempt to state how the boundary line of the stream is determined. I will simply say that it is not the edge of the high bank or bluff, it is not the edge of the cutbank, and it is not the edge of the water. For a detailed statement of how the boundary of the stream is determined, I refer you to the very fine article "The Gradient Boundary," by Col. Arthur A. Stiles, in 30 Texas Law Review 305.

One of the most interesting boundary suits in which I have had the pleasure of participating is that of Thiessen v. State, where it was sought to establish a vacancy around a part of the University land in Andrews County, near Shafter Lake. There had been five successive systems of surveys across this general area, and it was the function of the surveyors to locate the exact position of the ground of each of these five systems of surveys. In the course of this work, Mr. Moncrief, the very fine surveyor for Shell Oil Company, located a number of the piles of rocks placed for section markers by the T. & P. surveyors in 1872, who, by the way, had to work in that area with U. S. Calvary guards to protect them against Indian raids. Mr. Moncrief was successful in showing that subsequent surveyors had in some instances missed the locations of the T. & P. monuments by several hundred feet. The second of the five systems of surveys was made by a surveyor who apparently had measured distance by tying a handkerchief to his wagon wheel and counting the number of revolutions of the wheel, and who had estab-

lished monuments by taking bearings on nearby sand dunes, without saying which side of the sand dune he was sighting at, and by taking occasional bearings upon distant mountains, without saying which shoulder of the mountain he sighted on. Nevertheless, the modern surveyors, to my astonishment, were able to locate this line, which had been run over seventy-five years before, with a margin of error of only two or three hundred feet. This all goes to show that possibly you should use something more accurate than a wagon wheel to measure distance and should use something more permanent than a sand dune for a monument, and that when you take a bearing on a distant mountain, you should indicate which shoulder of the mountain you are sighting at.

Finally, there comes the question as to what information needs to be given to the attorney where there are two or more possible constructions of original survey lines or two or more possible constructions of the lines of tracts created by conveyances subsequent to the original survey. These matters involve the question of whether or not there are vacancies or conflicts between original surveys, and the question of how much land is conveyed by subsequent conveyances. On these matters a personal conference between the surveyor and the attorney is necessary. The surveyor will usually first make his own decision as to how the lines of original surveys and of subsequent tracts should be placed, and prepare a map showing his construction. He should then have a conference with the attorney and explain all of the problems which were met with in determining the question of the proper construction of the original surveys and the subsequent tracts. These include such matters as the question of whether, when there is a system of original surveys with a monument at one end and no monument at the other end and there is an excess or a shortage in distance encountered before reaching the next system of surveys, the surveys should be constructed by course and distance or the excess or shortage should be prorated or the excess or shortage should be thrown into the last survey; the question of whether, when there is a monument at both ends of a system of surveys and there is an excess or a shortage between the two monuments, the excess or shortage should be prorated or it should be thrown into the last survey; the question of whether, when there is a call for a senior survey line and the distance is short, the call for the senior survey line should be given precedence, or the call for distance should be given precedence, on the theory that the original surveyor called for the senior survey line through error? These and many other questions similar to them call for considerable thought and study, both as to the proper application of the rules of boundary law to the facts, and as to what should be done, if anything, to cure the defect. In many instances it is a question of business policy as to whether a vacancy application should be filed, a deed of acquittance should be obtained, or a lease from the State should be obtained. If all of these questions are brought to the front immediately, as soon as the survey is completed, and if an immediate decision can be made as to remedial measures, frequently much troublesome and expensive litigation can be avoided. For that reason it is recommended that the surveyor, by means of a personal conference, give the attorney the benefit of each and every question which has arisen in the surveyor's mind during the course of the survey, both as to identity of monuments and lines observed by the surveyor, and as to the several constructions which can be given to the surveys, in all of those instances where more than one construction is possible.

May I close by saying that working with surveyors has been one of the pleasantest parts of my thirty years of law practice, and that I appreciate this opportunity to visit with you.

Right of Entry of Land Surveyors to Private and Public Lands*

By ROBERT O. WILHELM

WILHELM AND BLATT

The private land surveyor has no right to enter upon private land without the consent of the owner or by authority of a Court Order. If he does enter upon private lands without consent or Order, he is liable for trespassing on other people's land.

There are three Code Sections which cover this point. The first one is Section 742 of the

* A memorandum to the California Council of Civil Engineers and Land Surveyors. *See* SURVEYING AND MAPPING, Vol. XVII, No. 4, October–December 1957, p. 449.

Code of Civil Procedure which is as follows:

"Order Allowing Party to Survey and Measure Land in Dispute.—The court in which an action is pending for the recovery of real property, or for damages for any injury thereto, or a judge thereof may, on motion upon notice by either party for good cause shown, grant an order allowing to such party the right to enter upon the property and make survey and measurement thereof, and of any tunnels, shafts, or drifts therein, for the purpose of the action, even though entry for such purpose has to be made through other lands belonging to parties to the action."

The second, Section 743, of the Code of Civil Procedure states as follows:

"Order, What to Contain and How Served: If Unnecessary Injury Done, the Party Surveying to be Liable Therefor.—The order must describe the property, and a copy thereof must be served on the owner or occupant; and thereupon such party may enter upon the property, with necessary surveyors and assistants and make such survey and measurement; but if any unnecessary injury be done to the property he is liable therefor."

The third, Section 27553 of the Government Code which is a follows:

"Order of Survey May be Directed to Another County. When the title of land which is in dispute before any court, is divided by a county line, the court making an order of survey may direct the order to the surveyor of any county in which any part of the land is situated."

There are no cases in the law in California on this subject, therefore, all written authorities are based simply on these three Code Sections.

The law in the State of California is best described in Cal. Jur. 2nd as follows:

"The Court in which an action is pending for the recovery of real property, or adjudged thereof, may, on motion and notice by either party for good cause shown, grant an order allowing to such party the right to enter the property and make a survey and measurement of it and of any tunnels, shafts, or drifts for the purpose of the action, even though entry for such purpose has to be made through other land belonging to the parties. The owner must describe the property and a copy must be served on the owner or occupant. Thereupon such party may enter on the property with necessary surveyors and assistants and make the survey and measurement; but if any unnecessary injury is done to the property he is liable therefor."

In any case in which the owner desires to have his property surveyed and where it is necessary in order to accomplish it, an entry must be made on adjacent property, the only manner in which this can be accomplished, if the adjacent owner objects to any entry, is by Court Order. The owner desiring the property to be surveyed can file an action against the objecting owner claiming that the adjacent owner is claiming some of his property. When this action has been filed and the party served, then a Motion can be made before the Court for a Court Order to allow the survey party to make entry upon his land for the purpose of ascertaining the correct boundary line. This is the only way in which entry can be made upon an objecting owner in a lawful manner.

The surveyor who does not secure a Court Order or permission to make entry can be sued by the land owner for any damages to the property in an action for trespassing. Therefore, it is the best to use public relations and acquire consent before making any entries.

The same rules should apply in regard to public lands. If the land is not restricted, then the surveyor has the right of entry on and over the land. However, if the land is restricted, then permission must be obtained from the authorities to enter upon the land.

Property Lines and Responsibility *

By ROBERT O. WILHELM

WILHELM AND BLATT

This memorandum opinion is in regard to some of the elementary principles of laws in regard to property lines and the responsibility of the civil engineer or land surveyor in making surveys.

The true location of the property lines of

* A memorandum to the California Council of Civil Engineers and Land Surveyors. *See* SURVEYING AND MAPPING, Vol. XVII, No. 4, October–December 1957, p. 449.

a parcel is a question of fact. The surveyor is a finder of the facts. It is his duty to locate on the ground, the property line as described in the conveyance or subdivision. When he has completed his survey, the surveyor must be able to take the witness stand in a Court of law and substantiate his position with the facts of how he determined the property line location in the position that he advocates. The question of the law on the subject of surveying is at that time immaterial.

It is only when all of the testimony has been received by the Court, that the law of surveying becomes an issue before the Court. At this time the accumulation of the facts are applied to the law on the subject and a determination made.

In every case, when the question of boundary lines is in dispute, there will be several surveyors testifying as to the proper location of the property lines. The testimony of the surveyor who has the ability to use the instruments of the trade with the highest degree of accuracy will not of necessity prevail. The surveyor who presents the facts which support the law on the subject is the one which the Court will follow in its decision.

Therefore, every surveyor should have knowledge of the law on the determination of property lines by surveying. His client employs him for the purpose of determining the proper physical location of property and being able to support his determination in Court.

The first thing that the Court looks for in the facts is the intent of the parties in the original grant which established the property line in question. The surveyor must be able to explain in Court the intent of the grantor and grantee in the original deed.

For example, suppose the courses if surveyed exactly as called for in the deed description leaves a small parcel of land remaining between the land conveyed by the deed and a known boundary line; also, that the parcel remaining is of no value to anyone; therefore, it is reasonable to assume that the original grant was intended to convey the in-between parcel also. This determination is not a dogmatic one, but one based on logic and rational reasoning.

The first things that a surveyor should look for in the field are monuments. The law is very prejudiced in the weight given to monuments.

The Code provisions are as follows:

CCP S 2077—Rules for construing description of lands.—The following are the rules for construing the descriptive part of a conveyance of real property, when the construction is doubtful and there are no other sufficient circumstances to determine it:

1. Where there are certain definite and ascertained particulars in the description, the addition of others which are indefinite, unknown, or false, does not frustrate the conveyance, but it is to be construed by the first-mentioned particulars.

2. When permanent and visible or ascertained boundaries or monuments are inconsistent with the measurement, either of lines, angles, or surfaces, the boundaries or monuments are paramount.

3. Between different measurements which are inconsistent with each other, that of angles is paramount to that of surfaces, and that of lines paramount to both.

4. When a road, or stream of water not navigable, is the boundary, the rights of the grantor to the middle of the road or the thread of the stream are included in the conveyance, except where the road or thread of the stream is held under another title.

5. When tide-water is the boundary, the rights of the grantor to ordinary high-water mark are included in the conveyance. When a navigable lake, where there is no tide, is the boundary, the rights of the grantor to low-water mark are included in the conveyance.

6. When the description refers to a map, and that reference is inconsistent with other particulars, it controls them if it appear that the parties acted with reference to the map; otherwise the map is subordinate to other definite and ascertained particulars.

The Surveyor who uses a monument in the establishment of his survey must be able to stand behind that monument in a Court of law. He must be able to prove by facts and reasoning that the monument is the one intended to be used by the original grantor and grantee.

The proof of the monument can take many forms. Following are a few which have been used by Courts in determining the sufficiency of a monument:

1. The calling of a monument by name. For example, the point of beginning of a description is the "Palo Alto Redwood." The surveyor can prove this monument by showing the Court that today there is in the community a tree known as the "Palo Alto Redwood." Also, that he questioned the oldest residents of the community and they told him that this tree has also been known in the community as the "Palo Alto Redwood" and to their knowledge there

has never been another tree in the community known as the "Palo Alto Redwood." Also that their grandfather and some oldtimers, long since deceased, told him that this tree has always been known as the "Palo Alto Redwood." It is interesting to note that this evidence is pure hearsay and ordinarily would not be allowed in a Court of law. However, in the present case it would be allowed, to show the facts [as to] how the surveyor located his lines.

2. The retracing of the original survey. This is done by taking the old field notes of the original surveyor and endeavoring to retrace his steps from the courses and distances, natural and reconstructed monuments, other objects described and fix the line precisely as called for in the original survey. The testimony of the surveyor, step by step, how he accomplished this procedure would be evidence of the correctness of his survey.

3. The information gained from questioning individuals who have knowledge of the facts. Suppose a deed gives as a point of beginning, "County Highway Marker #2148." The surveyor goes to the field and finds a County Highway Marker #2148. However, in running the survey from the deed, he finds that the fences and objects seem to be fifteen to twenty feet from where they should be. By questioning the local residents, he finds that the County Engineer, a number of years previously, had relocated the monument. Furthermore, his investigation at the County Engineer's Office proved that the County Survey Party by using a theodolite and an invar tape, with all the necessary corrections, had found that #2148, which was a quarter section monument, to be in error. In addition, he found that the monument had been relocated in confirmation of an administrative Order of the County Engineer, pursuant to an Ordinance of the County. With these facts so obtained, the surveyor returned to the field and relocated the position of the old marker #2148 from information gained from conversation with the local residents, field notes from the County and other prior surveyors. In this manner, the surveyor would be able to support his survey in a Court of law.

Also, to be remembered, is that property ownership is established by usage and legal right. That ownership of property is protected by the Constitution and can be affected only by due process of law. Therefore, the only way for property and location of that property to be changed is by due process of law. No administrative, executive, or legislative body has the right to change ownership of land except by due process of law. If the State needs the land, it can be acquired by eminent domain proceeding in which the owner received just compensation for his land. No right exists for any government agency or body to arbitrarily change the location of any line. No engineer or surveyor has the right to change any line. If he does, he subjects himself to a suit for damages. The suit would be for breach of contract and malpractice.

Every surveyor should remember that it is his responsibility for the proper location of property lines. It is for him alone to determine which monument to accept or reject in the establishment of the property. He cannot place the responsibility for his location of the line upon the opinion, directive, or order of any governmental agency or official.

Student Trainee Program at the N. B. S.

A program which gives students an opportunity to become acquainted with a Government research laboratory during their summer vacation periods is helping the National Bureau of Standards to meet its increasing demand for high-caliber technical graduates.

The Student Trainee Program, which enables college men and women to apply their education in jobs selected according to their interests, is proving mutually beneficial to employer and employee. Actual participation in laboratory work has been found to be not only an incentive for continuing scientific studies but also a help to the student in formulating career objectives and in integrating classroom work with actual laboratory experience.

Besides being successful as a long-range recruitment plan, the Student Trainee Program demonstrates the ability of younger employees to make direct contributions to research programs.

To gain eligibility on the register from which appointments to the program are made, college men and women must pass a written Civil Service Examination for Student Trainees. At the high-school level a limited number of direct appointments are offered winners in the Westinghouse Science Talent Search and other national science competitions. A student who has taken part in the program and is recommended by his supervisor may return each summer while he is completing his education. Trainee appointments are limited to science majors planning careers in the fields of research carried on at the Bureau.

Books in Review

SURVEYING. Charles B. Breed and Alexander J. Bone. *John Wiley & Sons, Inc.,* New York, 1957. xvii + 495, illus. $5.50.

This is a second and revised edition of *Surveying,* originally published in 1942, which was designed for use as a text under modern conditions, where the time allotted to instruction in surveying has been pared to a minimum. The second edition has been rewritten and expanded to include additional material on photogrammetry, coverage of modern optical-reading theodolites, material on the self-leveling or "automatic" level, and other features of surveying which have undergone considerable change in the fifteen-year period since the original text was published.

The text is well and copiously illustrated. The usual tables are included, although those relating to circular curves are nowhere near as complete as will be found in the usual text on route surveying.

The book is 5 × 7¼ inches in size, has flexible covers, is well printed (on paper which does not "glare" under artificial light), and should be a very usable text for a general or first course in surveying.

Coverage of the various features of surveying seems to be very complete, when one considers that in this day and age a single-volume text, which attempts to cover "surveying" and not just some one feature of the subject, could easily run to a thousand or more pages and still require leaving out much useful detail.

HOWARD S. RAPPLEYE

BEGINNINGS OF THE AMERICAN RECTANGULAR LAND SURVEY SYSTEM, 1784–1800. William D. Pattison, University of Chicago, Department of Geography Research Paper No. 50, Chicago, 1957. 248 pp. (16 ill.)

A striking and distinctive aspect of much of the American landscape west of the Appalachians is the geometrically regular pattern of roads, fields, and streets. The story of the conception of the rectangular land-survey system and the early years of its existence is related by Mr. Pattison in this scholarly and informative study.

Submitted as a dissertation for the Ph.D. degree in geography at the University of Chicago, Mr. Pattison's essay aims "to increase our understanding of the American rectangular land-survey system." As originators of that system he gives joint credit to Thomas Jefferson and Hugh Williamson of North Carolina who were members of a committee of the Continental Congress named "to devise and report the most eligible means of disposing of such part of the Western lands as may be obtained of the Indians by the proposed treaty of peace and for opening a land office."

Historians, geographers, surveyors, and cartographers will all find much of interest in this publication. The text is fortified with numerous footnote references and there is appended to the volume a lengthy bibliography.

WALTER W. RISTOW

Library of Congress

CITY PLANNING: A BASIC BIBLIOGRAPHY—With Special Reference to Civil Engineering and Land Surveying. George C. Bestor and Holway R. Jones. *California Council of Civil Engineers and Land Surveyors,* 1107 Ninth Street, Sacramento 14, Calif. August 1957.

In 1955, George C. Bestor was chairman of a Committee on City Engineering and Land Planning for the California Council of Civil Engineers and Land Surveyors. Because every member of the Council practices in some fields of municipal development and improvement, Mr. Bestor decided to prepare for the membership a reading guide on that subject of the material available in California libraries. His "Bibliography" and "Suggested Reading List" were published in mimeographed form in January 1956.

During 1956 and the first six months of 1957, Holway R. Jones edited and expanded the "Bibliography" to the form in which it is now published as a carefully selected catalogue (with comments) of materials currently available in four California libraries on land planning and related subjects. Included are lists on Land Subdivision and Subdivision Regulation.

Mr. Bestor is a Registered Civil Engineer and Land Surveyor, practicing in Carmel, Calif. Mr. Jones is Librarian, City and Regional Planning Library, University of California, Berkeley, Calif. This book was prepared as a public service and published in August 1957 by the California Council of Civil Engineers and Land Surveyors.

Mr. Bestor (ACSM's new Vice President) in-

forms me that copies may be obtained, while they last, if members from other States interested in using such a bibliography will write to the Sacramento address of the Council.

WALTER S. DIX
Executive Secretary, ACSM

SURVEYING. William Horace Rayner and Milton O. Schmidt. *D. VanNostrand Company, Inc.*, Princeton, New Jersey, 1957. 916 pages. $8.50.

This is an excellent textbook, complete with tables, for engineering college students and stresses the idea that "Surveying must be treated as an indispensable part in the economical design and construction of civil engineering projects." Both the beginning and advanced student will find this book an accurate, concise, and interesting text and will also use it later as a handbook for professional practice.

Part A, Elementary Surveying, contains the following basic subjects: use and adjustment of instruments, construction surveys, and land surveying (within the Public Land System).

Part B, Advanced Surveying, contains more detailed data on the basic subjects as well as triangulation, azimuth determination, traverse, State coordinate systems, leveling, and photogrammetry; as well as hydrographic, topographic, mining, and special surveys; and concludes with a brief history of surveying.

This division between elementary and advanced surveying may well be an invaluable teaching aid, but it will prove to be confusing for the practicing surveyor to refer to this book and find that most subjects will be found in several sections, with the exact answer seemingly escaping his grasp.

In this modern age of using optical-reading instruments and streamlining our subjects and projects, and in keeping with the authors' idea of "concise, but clear exposition of fundamentals"; it would seem that the subject of adjustment of instruments could be omitted almost entirely. Instruction booklets covering the use of such instruments and the making of minor adjustments of them are furnished by all manufacturers. In private practice, adjustments are usually brought about by accidents requiring the professional services of a reputable repairman.

One basic criticism of this book, and perhaps of all civil engineering curriculums in general, is the idea that "the details of technique are properly left to be acquired outside the classroom and in subsequent professional practice." This theory may well account for the fact that few if any modern civil engineering graduates ever practice surveying other than as a stepping stone to design jobs. After all, a civil engineering graduate is incapable of acting as a party chief or a designer-computer. Therefore, it is uneconomical to at once start private practice of surveying. Many of these little details, the kind that make or break the profit on a job, seem to be omitted or passed over lightly:

Use of hand levels in chaining and leveling,

Waving a leveling rod vs. balancing the rod,

Use of rod levels in traversing and leveling,

Proper marking of turning points to avoid loss and/or confusion,

Use of plumb-bob targets in traversing,

Use of plastic tapes in rough chaining,

Use of azimuths reckoned from South as "zero,"

Use of a new tape or chain instead of repairing same,

Use of instruments at heights above the ground corresponding to the observer's eye level,

Use of standard computation forms complete with coordinate columns,

Parallax adjustment may be a continuing correction as the observer's eye becomes tired.

Use of the compass is definitely *not* obsolete for retracing boundaries in the original thirteen States,

Railroad curves vs. highway curves,

Land surveying methods in areas other than those covered by the Public Land System,

Computations in subdivision design,

Types of stakes and/or hubs and stake tacks,

Use of spring balance to correct chain to even length, and

Membership in the American Congress on Surveying and Mapping.

The references for the chapter on Precise Determination of Azimuth fail to mention the outstanding USC&GS Special Publication 237, "Manual of Geodetic Astronomy."

The references for the chapter on Precise Traverse fail to mention most important USC&GS Special Publications 137, "Manual of First Order Traverse," and 145, "Manual of Second and Third Order Triangulation and Traverse." If the authors are not familiar with these publications, this chapter should be revised after study of them. The authors' use of the word "precise" for other than first order work is questionable.

The chapter on topographic mapping also lacks a reference to USC&GS Special Publi-

cations 144, "Topographic Manual," and 249, "Topographic Manual, Part II," but seems to be very well written and includes a paragraph on State Bureaus of Surveying and Mapping. The basic idea of setting up these Bureaus is excellent. In most cases enabling legislation does not include the source of budget money, and, therefore, these agencies never seem to function in a worthwhile manner. Certainly the authors deserve commendation for coverage of this item, and it is to be hoped that the students will be able to do much to further these agencies in the future.

The authors also deserve praise for the many words of advice and warning included in this book, but it is doubtful if the student will realize their importance when the practicing surveyor is often at a loss to interpret them. "The best surveyor is one who is able to choose and apply just that degree of precision requisite to his purpose." How can this statement be properly applied when everyone and everything is subject to checks by others? One should feel that the job must be done well. It seems that everyone, courts included, expect good work, regardless of the time or price. Who can foresee with complete certainty the specifications necessary for each job to stand the test of time? A simple farm-boundary survey of today becomes a precise framework for subdivision design tomorrow, or a contour line located within an accuracy limit of half the contour interval may become an extra-work cost item in designing the footings for a large structure. More power to the authors if items such as these can be brought to the attention of the student as well as the practicing surveyor.

DRAPER K. SUTCLIFFE

R.L.S., Maryland

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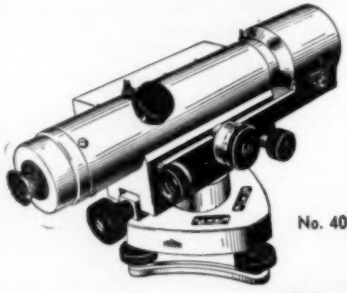
Micrometer reading to 1/1000 in., magnification 42x, sensitivity of telescope level 8″/2 mm, reading by coincidence to 0.2″, mean accuracy per 1000 m ± 0.4 mm.



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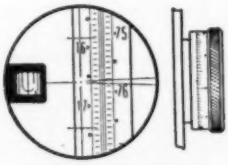

Reading example

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LAND AND MINE SURVEYING INSTRUMENTS • FOUNDED IN 1762

MAP INFORMATION

This department was inaugurated for the purpose of bringing to the attention of the members information pertaining to the availability of maps, surveys, etc., with particular emphasis on how such material can be procured. It is believed that through an interchange and dissemination of such information maximum benefits will accrue to the surveying and mapping profession.

Topographic Maps

THE FOLLOWING quadrangle maps were published or became available for distribution by the U. S. Geological Survey between September 1 and November 30, 1957. The list includes newly compiled maps; revised maps on which contours and drainage usually are unchanged but the works of man are brought up to date; and series-converted maps which are 15-minute maps produced from four 7½-minute maps of the same area. The maps are new unless otherwise designated by numerical superscript.

The quadrangle name (in capital letters) is followed by the name of the county (in upper- and lower-case letters) that contains the place or feature for which the quadrangle is named.

All maps are available with or without the green overprint that indicates woodland. These maps show the shape and elevation of the land surface (represented by contour lines, printed in brown); water features (in blue); works of man, including cities, towns, and scattered habitations, schools, churches, railroads, roads and boundaries, place and feature names (in black); and woodland areas (in green). Principal roads are shown by a red overprint. In areas that have been covered by Bureau of Land Management surveys, township and section lines are shown. The State rectangular coordinate and the UTM 1,000-meter grid systems are indicated in the margins of the maps. An information folder further describing topographic maps is available on request.

Standard quadrangle maps may be obtained for 30 cents per copy. A discount of 20 percent is allowed on orders amounting to $10 or more at the retail price; a discount of 40 percent is allowed on orders amounting to $60 or more. Orders should be addressed to the U. S. Geological Survey, Washington 25, D. C., (or Denver 15, Colo., for maps of areas west of the Mississippi River).

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* Indicates 15-minute quadrangles; all others are 7½-minute quadrangles.
[1] Indicates a revised map.
[2] Indicates a series-converted map.
† Indicates availability in either a contour or a shaded relief edition.
‡ Indicates preliminary black and white edition.

Alaska

CANDLE (D-5)*—Second Judicial Division
CANDLE (D-6*)—Second Judicial Division
CRAIG (B-5)*—First Judicial Division
DIXON ENTRANCE (D-2)*—First Judicial Division
FAIRBANKS (A-6)*—Fourth Judicial Division
KANTISHNA RIVER (B-1)*—Fourth Judicial Division
KANTISHNA RIVER (B-5)*—Fourth Judicial Division
KANTISHNA RIVER (C-5)*—Fourth Judicial Division
KANTISHNA RIVER (C-6)*—Fourth Judicial Division
KANTISHNA RIVER (D-6)*—Fourth Judicial Division
KATEEL RIVER (A-2)*—Fourth Judicial Division
KATEEL RIVER (A-3)*—Fourth Judicial Division
KATEEL RIVER (A-4)*—Fourth Judicial Division
KOTZEBUE (A-1)*—Second Judicial Division
KOTZEBUE (A-2)*—Second Judicial Division
KOTZEBUE (A-3)*—Second Judicial Division
KOTZEBUE (A-4)*—Second Judicial Division
KOTZEBUE (A-5)*—Second Judicial Division
KOTZEBUE (A-6)*—Second Judicial Division
KOTZEBUE (B-4)*—Second Judicial Division
KOTZEBUE (B-5)*—Second Judicial Division
KOTZEBUE (B-6)*—Second Judicial Division
KOTZEBUE (C-4)*—Second Judicial Division
KOTZEBUE (C-5)*—Second Judicial Division
KOTZEBUE (C-6)*—Second Judicial Division
KOTZEBUE (D-1)*—Second Judicial Division
MELOZITNA (A-2)*—Fourth Judicial Division
MIDDLETON ISLAND (B-7)*—Third Judicial Division
MT. McKINLEY (B-1)*—Fourth Judicial Division

MT. McKINLEY (B-2)*—Fourth Judicial Division
MT. McKINLEY (B-3)*—Fourth Judicial Division
MT. McKINLEY (C-3)*—Fourth Judicial Division
NORTON BAY (D-1)*—Fourth Judicial Division
NULATO (A-2)*—Fourth Judicial Division
NULATO (A-4)*—Fourth Judicial Division
NULATO (A-5)*—Fourth Judicial Division
NULATO (B-1)*—Fourth Judicial Division
NULATO (B-2)*—Fourth Judicial Division
NULATO (B-3)*—Fourth Judicial Division
NULATO (B-4)*—Fourth Judicial Division
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NULATO (C-4)*—Fourth Judicial Division
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PETERSBURG (A-1)*—First Judicial Division
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PETERSBURG (A-6)*—First Judicial Division
PETERSBURG (B-1)*—First Judicial Division
PETERSBURG (B-2)*—First Judicial Division
PETERSBURG (B-6)*—First Judicial Division
PETERSBURG (C-1)*—First Judicial Division
PORT ALEXANDER (B-1)*—First Judicial Division
PORT ALEXANDER (C-1)*—First Judicial Division
RUBY (D-4)*—Fourth Judicial Division
RUBY (D-5)*—Fourth Judicial Division
RUBY (D-6)*—Fourth Judicial Division
SELAWIK (A-5)*—Second Judicial Division
SELAWIK (A-6)*—Second Judicial Division
SELAWIK (B-6)*—Second Judicial Division
SELAWIK (C-6)*—Second Judicial Division
SHISHMAREF (A-1)*—Second Judicial Division
SHISHMAREF (A-2)*—Second Judicial Division
SHISHMAREF (A-3)*—Second Judicial Division
SHISHMAREF (A-4)*—Second Judicial Division
SHISHMAREF (B-1)*—Second Judicial Division
SHISHMAREF (B-2)*—Second Judicial Division
SHISHMAREF (B-3)*—Second Judicial Division
SUMDUM (A-4)*—Third Judicial Division
SUMDUM (A-5)*—Third Judicial Division
SUMDUM (A-6)*—Third Judicial Division
TANANA (A-5)*—Fourth Judicial Division
TANANA (A-6)*—Fourth Judicial Division

Arizona

CHANDLER—Maricopa
ENID[1]—Pinal
FOWLER—Maricopa
GILA BUTTE—Pinal
GILA BUTTE NW—Pinal
GILA BUTTE SE—Pinal
GUADALUPE—Maricopa
LAVEEN—Maricopa
LONE BUTTE—Maricopa
MARICOPA—Pinal
MESA—Maricopa
MONTEZUMA PEAK—Pinal
PHOENIX—Maricopa
PIMA BUTTE—Pinal
SACATON BUTTE—Pinal
TEMPE—Maricopa
‡ZITH-TUSAYAN BUTTE 2 NE—Apache
‡ZITH-TUSAYAN BUTTE 2 NW—Apache
‡ZITH-TUSAYAN BUTTE 2 SE—Apache
‡ZITH-TUSAYAN BUTTE 2 SW—Apache

California

ADELANTO—San Bernardino
ALMANOR*—Plumas
AMOS—Imperial
APPLE VALLEY*—San Bernardino
BIG SUR—Monterey
CANTUA CREEK—Fresno
CECILVILLE*—Siskiyou
CEDAR MTN.—Alameda
COFFEE CREEK*—Trinity
EL MIRAGE—San Bernardino
EMIGRANT GAP*—Placer
ETNA*—Siskiyou
FIVE POINTS—Fresno
FORKS OF SALMON*—Siskiyou
FORT JONES*—Siskiyou
FREMONT PEAK*—San Bernardino
FRINK NW—Imperial
HALLORAN SPRING*—San Bernardino
HARRIS RANCH—Fresno
HORNBROOK*—Siskiyou
HURON—Fresno
INDIO—Riverside
KELSO*—San Bernardino
KINGSTON PEAK*—San Bernardino
LAKE ARROWHEAD*—San Bernardino
LANFAIR VALLEY*—San Bernardino
LATON[1]—Fresno
LILLIS RANCH—Fresno
LOPEZ POINT—Monterey
MECCA—Riverside
MID HILLS*—San Bernardino
MOJAVE*—Kern
MONTARA MTN.[1]—San Mateo
NILAND—Imperial
OASIS—Riverside
PARTINGTON RIDGE—Monterey
RIVERDALE[1]—Fresno
SAN MATEO[1]—San Mateo
SAN NICOLAS ISLAND—Ventura
SAWYERS BAR*—Siskiyou
SEIAD VALLEY*—Siskiyou
SIERRA CITY*—Sierra
SISTER ROCKS—Del Norte
TORTUGA—Imperial
TRANQUILLITY—Fresno
TRES PICOS FARMS—Fresno
UKONOM LAKE*—Siskiyou
VICTORVILLE—San Bernardino
WESTHAVEN—Fresno
WESTSIDE—Fresno
WIEST—Imperial

Colorado

BUENA VISTA*—Chaffee
ANTERO RESERVOIR—Park
CHEESMAN LAKE—Jefferson
CIMARRON—Montrose
CURECANTI NEEDLE—Gunnison
DAKAN MOUNTAIN—Douglas
EAGLE ROCK—Park
ELEVENMILE CANYON—Park
FARNUM PEAK—Park
GARO—Park
GLENTIVAR—Park
GUFFEY NW—Park
HACKETT MTN.—Teller
HANDIES PEAK—Hinsdale
HARTSEL—Park
LAKE GEORGE—Park
SULPHUR MOUNTAIN—Park

Delaware

DOVER—Kent
FREDERICA[1]—Kent
SMYRNA[1]—Kent

Delaware-Maryland

MARYDEL—Kent

Florida

ARSENICKER KEYS[1]—Dade
CARD SOUND[1]—Monroe
ELLIOTT KEY[1]—Dade
GLADES[1]—Dade
GOULDS[1]—Dade
HOMESTEAD[1]—Dade
PACIFIC REEF[1]—Dade
PERRINE[1]—Dade
SOLDIER KEY[1]—Dade
SOUTH MIAMI NW[1]—Dade

Georgia

BAINBRIDGE*—Decatur
BOLINGBROKE*—Monroe
CONYERS—Rockdale
DULUTH—Gwinnett
FORT VALLEY*—Peach
GARDEN CITY—Chatham
GORDON*—Wilkinson
KENNESAW—Cobb
NORCROSS—Gwinnett
PERRY*—Houston
ROSWELL—Fulton
SNELLVILLE—Gwinnett
STONE MOUNTAIN—De Kalb
WARNER ROBINS*—Houston
WHIGHAM*—Grady

Hawaii

AHUMOA—Hawaii
KAMUELA—Hawaii
KEANAKOLU—Hawaii
KOKOOLAU—Hawaii
KULANI—Hawaii
MAUNA KEA—Hawaii
PUA AKALA—Hawaii
PUU OO—Hawaii
PUU O UO—Hawaii
PUU ULAULA—Hawaii
UMIKOA—Hawaii

Idaho

BURGDORF*—Idaho
CINDER CONE BUTTE—Ada
CRATER RINGS—Elmore
CRATER RINGS SW—Elmore
MOUNTAIN HOME NORTH—Elmore
MOUNTAIN HOME SOUTH—Elmore
REVERSE—Elmore
WARREN*—Idaho

Illinois

MATHERVILLE—Mercer
VIOLA—Mercer

Illinois-Iowa

CORDOVA—Rock Island
PORT BYRON[1]—Rock Island

Indiana

ALFORDSVILLE—Daviess
BLOCHER—Scott
CLIFTY FALLS—Jefferson
CLOVERDALE—Putnam
DEPUTY—Jefferson
OTISCO—Clark
PATRICKSBURG—Owen
VOLGA—Jefferson

Iowa
GLENWOOD—Mills
MINEOLA—Mills

Iowa-Illinois
CAMANCHE—Clinton

Iowa-Nebraska
ROCK BLUFF—Cass

Kansas
ELLINWOOD NW—Barton

Kentucky
SUTHERLAND[1]—Daviess

Kentucky-Indiana
OWENSBORO EAST[1]—Daviess
OWENSBORO WEST[1]—Daviess

Louisiana
BOYCE*[1]—Rapides
COLFAX*[1]—Grant
FOREST HILL*[1]—Rapides
MONTGOMERY*[1]—Grant

Maine-New Hampshire
ISLES OF SHOALS[1]—York

Massachusetts
CHESTER[1]—Hampden
LYNN[1]—Essex
WESTHAMPTON[1]—Hampshire

Massachusetts-Connecticut
WEST GRANVILLE[1]—Hampden

Michigan
BERGLAND*—Ontonagon
BERGLAND NE*[1]—Ontonagon
CARP RIVER*—Ontonagon
FOSTER CITY*—Dickinson
KIERNAN[1]—Iron
LAKE MARY[1]—Iron
MANCELONA*—Antrim
MICHIGAMME—Marquette
MICHIGAMME*—Marquette
THOMASTON*—Gogebic
THREE LAKES—Baraga

Michigan-Wisconsin
BEECHWOOD*—Iron
NORTH IRONWOOD*—Gogebic

Montana
BATTLE BUTTE—Stillwater
BELT*—Cascade
BRIDGER—Carbon
COLUMBUS EAST—Stillwater
COLUMBUS WEST—Stillwater
EMERALD LAKE—Stillwater
GORE HILL*—Cascade
HIGHWOOD*—Chouteau
HORSE BUTTE—Stillwater
HUNTER LAKE—Stillwater
MACKAY RANCH—Carbon
MADDUX*—Blaine
MOLT—Stillwater
RAPELJE—Stillwater
RATTLESNAKE*—Blaine
ROSCOE—Carbon
ROSCOE NW—Carbon
SPRINGTIME—Stillwater
STOCKETT*—Cascade
WHEAT BASIN—Stillwater
WORK CREEK—Sweet Grass

Montana-Wyoming
ALPINE*—Carbon

Nebraska
BARTLEY NW—Frontier
CEDAR CREEK—Cass
CURTIS NW—Frontier
CURTIS SE—Frontier
CURTIS SW—Frontier
DICKENS—Lincoln
FREEDOM—Frontier
GRETNA—Sarpy
JEFFREY RESERVOIR SW—Lincoln
MOOREFIELD—Frontier
QUICK NE—Frontier
SOMERSET—Lincoln
SPRINGFIELD—Sarpy
STOCKVILLE—Frontier
STOCKVILLE NE—Frontier
WEEPING WATER NE—Cass
WELLFLEET—Lincoln
WELLFLEET NE—Lincoln
WHITE NE—Hayes

Nevada
ACKERMAN CANYON*—Lander
ANTELOPE PEAK*—Eureka
BELLEVUE PEAK*—Eureka
COCKALORUM WASH*—Nye
HORSE HEAVEN MTN.*—Nye
MOUNT CALLAGHAN*—Lander
MT. GRANT*—Mineral
NORTH SHOSHONE PEAK*—Nye
SOUTH SHOSHONE PEAK*—Nye
OREANA*—Pershing
ROBINSON MTN.*—Elko
TOULON*—Pershing
WALTI HOT SPRINGS*—Eureka

Nevada-California
AURORA*—Mineral
SHENANDOAH PEAK*—Clark

New Jersey
BOUND BROOK[1]—Middlesex
DIVIDING CREEK—Cumberland
DOROTHY—Atlantic
EGG HARBOR CITY—Atlantic
POINT PLEASANT—Ocean
PORT ELIZABETH—Cumberland
RIO GRANDE—Cape May
SEASIDE PARK—Ocean
TUCKAHOE—Cape May

New York-New Jersey
RAMSEY[1]—Bergen

New Mexico
CIMARRON*—Colfax
EDGEWOOD*—Sante Fe
HOPE NW—Eddy
MIAMI*—Colfax
PARISH RANCH—Eddy
TOOTH OF TIME*—Colfax
UTE PARK*—Colfax

New Mexico-Colorado
BRAZOS PEAK*—Rio Arriba
LUMBERTON*—Rio Arriba

New York
CAMDEN EAST[1]—Oneida
CENTRAL ISLIP—Suffolk
DANNEMORA*—Clinton
GARDINERS ISLAND EAST—Suffolk
GARDINERS ISLAND WEST—Suffolk
JORDAN—Onondaga
LAKE PLEASANT*—Hamilton
LYNBROOK[1]—Nassau
MONTAUK POINT—Suffolk
PISECO LAKE*—Hamilton
PORT JEFFERSON—Suffolk
QUOQUE—Suffolk
REMSEN[1]—Oneida
SAINT REGIS*—Franklin
UTICA EAST[1]—Oneida
WESTFIELD—Chautauqua
WESTERNVILLE[1]—Oneida

New York-Connecticut
ORIENT—Suffolk

New York-New Jersey
ARTHUR KILL—Richmond
CONEY ISLAND—Kings
SLOATSBURG—Rockland
THE NARROWS—Richmond

North Dakota
ELLENDALE NORTH—Dickey
STRAUBVILLE—Sargent

North Dakota-South Dakota
HAVANA—Sargent
HECLA—Brown
HECLA NE—Brown
SAVO NE—Brown
SAVO NW—Brown

Oklahoma
OKLAHOMA CITY*—Oklahoma
SAND SPRINGS—Tulsa
SAPULPA NORTH—Creek

Oregon
BLAINE*—Tillamook
COLTON*—Clackamas
CULP CREEK*—Lane
FAIRDALE*—Yamhill
FAIRVIEW PEAK*—Lane
HARDESTY MTN.*—Lane
LAKE O'WOODS*—Klamath
ROSEBURG*—Douglas
VERNONIA*—Columbus

Pennsylvania
DONEGAL[1]—Westmoreland
ELVERSON—Chester
LANSDOWNE[1]—Delaware
MILLERSTOWN[1]—Perry
NEW HOLLAND—Lancaster
READING—Berks
WAGONTOWN—Chester

Pennsylvania-New Jersey
BEVERLY[1]—Burlington

Puerto Rico
MAYAGUEZ[1]—Mayaguez

Rhode Island
CHEPACHET[1]—Providence
CLAYVILLE[1]—Providence
COVENTRY CENTER[1]—Kent
SLOCUM[1]—Washington

Rhode Island-Connecticut
WATCH HILL[1]—Washington

South Carolina
BLUFFTON—Beaufort
FROGMORE—Beaufort
PARRIS ISLAND—Beaufort

South Carolina-Georgia
FORT PULASKI—Chatham

South Dakota
ALLEMAN STATION—Haakon
BLACK HORSE NE—Corson
BLACK HORSE SE—Corson
BLACK HORSE SW—Corson
BRITTON WEST—Marshall
BULLHEAD—Corson
BULLHEAD SW—Corson
CARLIN FLAT—Haakon
CHERRY CREEK—Ziebach
CHERRY CREEK NW—Ziebach
CLAREMONT—Brown
COTTONWOOD CREEK NE—Corson
COTTONWOOD CREEK NW—Corson
COTTONWOOD CREEK SE—Corson
COTTONWOOD CREEK SW—Corson
CROCKETT MOUNTAINS—Stanley
DOLAND SW—Spink
EDGEMONT—Fall River
GLENDALE COLONY—Spink
HERBERT CREEK SE—Dewey
KIRLEY—Haakon
LAKE BYRON—Beadle
LAKE BYRON NW—Beadle
LAKE BYRON SE—Beadle
LITTLE EAGLE—Corson
LITTLE EAGLE NW—Corson
LITTLE EAGLE SE—Corson
LITTLE EAGLE SW—Corson
MISCOL NE—Corson
MISCOL SE—Corson
MISCOL SW—Corson
ROUSSEAU CREEK SW—Dewey
SANSARC NE—Stanley
SPINK COLONY—Spink
WAKPALA—Corson
WAKPALA NW—Corson
WAKPALA SE—Corson
WAKPALA SW—Corson

South Dakota-North Dakota
NEWARK NW—Marshall

Tennessee
DICKSON—Dickson
LYLES—Hickman
McEWEN—Humphreys
TENNESSEE CITY—Dickson
TEXAS HOLLOW—Hickman
THETA—Maury
WOOLWORTH—Humphreys

Texas
ABBOTT—Hill
ADDICKS*—Harris
ALGERITA*[2]—San Saba
ANDREA RANCH—Hidalgo
ARMSTRONG—Kenedy
CLIFTON*[2]—Bosque
DAWSON—Navarro
EAST BROWNSVILLE[1]—Cameron
EMORY*—Rains
FORTRESS CLIFF—Randall
HUBBARD—Hill
IRENE—Hill
LAGUNA ATASCOSA[1]—Cameron
LOS AMIGOS WINDMILL—Kenedy
LOS FRESNOS[1]—Cameron
NEW DEAL—Lubbock
OLMITO[1]—Cameron
PENELOPE—Hill
PRAIRIE HILL—Limestone
QUINLAN*—Hunt
RUDOLPH—Kenedy
SAN PEDRO RANCH—Kenedy
SHALLOWATER—Lubbock
SLOOP CREEK—Archer
SUGAR LAND*—Fort Bend
VALLEY SPRING*[2]—Llano
WEST—McLennan

Texas-Louisiana
DEADWOOD*—Panola

Utah
CASTLE VALLEY*—Grand
DESERET PEAK*—Tooele
ENOCH*—Iron
FRUITA*—Wayne
GRANTSVILLE—Tooele
ISLAND PARK—Uintah
MOODY CREEK*—Garfield
TIDWELL BOTTOMS*—Emery
TIMPIE*—Tooele
TOOELE[1]—Tooele

Utah-Arizona
BUCKSKIN GULCH*—Cane
NO MANS MESA*—San Juan

Utah-Colorado
JONES HOLE—Uintah
STUNTZ RESERVOIR—Moffat

Vermont
GUILDHALL*[1]—Essex
WILMINGTON*[1]—Windham

Virginia
CHARLOTTE COURT HOUSE*—Charlotte
GLADYS*—Campbell

Virginia-North Carolina
MILTON*—Caswell

Washington
ARLINGTON EAST—Snohomish
ARLINGTON WEST—Snohomish
BLAINE—Whatcom
DUNGENESS—Clallam
EPHRATA SW—Grant
FERNDALE—Whatcom
GRANT ORCHARDS—Grant
JUNIPER BEACH—Island
LAKE STEVENS—Snohomish
MARYSVILLE—Snohomish
MOSES LAKE NORTH—Grant
MOSES LAKE SOUTH—Grant
ORTING—Pierce
STANWOOD—Snohomish
STUART ISLAND—San Juan
SUMNER—Pierce
TULALIP—Snohomish
WILSON CREEK NW—Grant
WILSON CREEK SE—Grant
WINCHESTER NE—Grant
WYNOOCHEE VALLEY*—Grays Harbor

Washington-Oregon
GRAYS RIVER*[1]—Wahkiakum

Wisconsin
CLINTONVILLE*—Waupaca
EMBARRASS*—Waupaca
FREDERIC*—Polk
GILLETT*—Oconto
HERTEL*—Burnett
IRON BELT—Iron
OCONTO*—Oconto
RIPON*—Fond du Lac
ROSENDALE*—Fond du Lac
ROSHOLT*—Portage
SAXON—Iron
TIGERTON*—Shawano

Wisconsin-Michigan
PHELPS*—Vilas

Wyoming
DEVILS TOWER*—Crook

In addition to the standard series of quadrangle maps, small-scale (1:250,000) maps of areas in the United States and Territories are being published and distributed. They may be purchased from the Geological Survey for 50 cents per copy. An index to the series is available on request.

Alaska
AFOGNAK†
KARLUK†
MT. KATMAI†

Alabama
ANDALUSIA

Alabama-Mississippi-Louisiana
MOBILE

California
LONG BEACH†

Iowa
DES MOINES

Kansas
MANHATTAN

Minnesota-North Dakota
THIEF RIVER FALLS

Mississippi-Louisiana
MERIDIAN

Nebraska
NORTH PLATTE

North Dakota
WATFORD CITY
WILLISTON

Oklahoma
CLINTON

Oregon-Washington
PENDLETON
THE DALLES

South Dakota
RAPID CITY

South Dakota-North Dakota
LEMMON

Texas
BEAUMONT
PECOS
SAN ANTONIO

Texas-Louisiana
PALESTINE

Special metropolitan-area and vicinity maps of major United States cities are being published and distributed by the Geological Survey. These maps are prepared from standard 7½-minute maps at the scale of 1:24,000. Vicinity maps may be purchased from the Geological Survey for the prices indicated below.

FORT WORTH AND VICINITY (42 by 53 inches) $1.50

State maps are also being published and distributed. These maps may be purchased from the Geological Survey for the prices indicated below:

#ARIZONA (base). (23 by 27½ inches) 1:1,000,000 scale. 20¢.
#COLORADO (base). (21 by 27 inches) 1:1,000,000 scale. 20¢.
#COLORADO (base map). (44 by 53 inches) 1:500,000 scale. $1.
COLORADO (topographic). (44 by 53 inches) 1:500,000 scale. $2.
#KANSAS (base map). (34 by 56 inches) 1:500,000 scale. 50¢.
#VIRGINA (base). (15½ by 32 inches) 1:1,000,000 scale. 20¢.
#VIRGINIA (base map). (29 by 64 inches) 1:500,000 scale. $1.
VIRGINIA (topographic). (30 by 64 inches) 1:500,000 scale. $2.
#VIRGINIA (relief). (30 by 64 inches) 1:500,000 scale. $2.

# Indicates the map does not show contours.

Lake Survey Charts

PUBLICATION of new editions of the following Lake Survey Charts has been announced by the United States Lake Survey of the Corps of Engineers, U. S. Army. Copies of these charts may be obtained from the U. S. Lake Survey, 630 Federal Building, Detroit 26, Mich., at 75 cents per copy. Payment is required in advance by P. O. money order or draft, payable to the Treasurer of the United States. A catalog showing the areas described below is available free upon request.

7.—Lake Michigan. General chart of entire lake at 1 : 500,000 scale. (June 1957)

41.—Detroit River. Three miles south of Detroit River Light to Windmill Point, Mich., at 1 : 30,000 scale. (October 1957)

76.—South Haven, Mich., to Benona, Mich., at 1 : 120,000 scale. Insets : South Haven, Mich., at 1 : 10,000 scale ; Saugatuck, Mich., at 1 : 15,000 scale. (May 1957)

77.—Benona, Mich., to Point Betsie, Mich., at 1 : 120,000 scale. Insets : Pentwater, Mich., and Frankfort, Mich., at 1 : 10,000 scale. (May 1957)

702.—Green Bay from Point Detour to Baileys Harbor and Menominee, Mich., including entrance to Green Bay, at 1 : 80,000 scale. Insets : Detroit Harbor, Wis., and Jackson Harbor, Wis., at 1 : 20,000 scale. (May 1957)

706.—Grand Traverse Bay and Little Traverse Bay, Mich., at 1 : 80,000 scale. Insets : Petoskey, Mich., and Harbor Springs, Mich., at 1 : 10,000 scale. Traverse City, Mich., at 1 : 15,000 scale. (May 1957)

723.—Menominee Harbor, Mich., and Marinette Harbor, Wis., at 1 : 15,000 scale. (September 1957)

725.—Head of Green Bay, Wis., and Fox River below De Pere, Wis., at 1 : 25,000 scale. Inset : Part of Green Bay, Wis., at 1 : 10,000 scale. (September 1957)

735.—Manitowoc Harbor, Wis., and Sheboygan Harbor, Wis., at 1 : 10,000 scale. (September 1957)

774.—Ludington, Mich., and Pere Marquette Lake, at 1 : 5,000 scale. (September 1957)

777.—Portage Lake, Mich., at 1 : 10,000 scale. (September 1957)

Public Land Survey Plats

THE FOLLOWING plats of public land surveys and resurveys were completed and accepted by the Bureau of Land Management between September 1 and November 30, 1957. The class or purpose of the survey is indicated. Copies of plats may be secured from the Bureau offices in the States or from the Director, Bureau of Land Management, Department of the Interior, Washington 25, D. C.

Arizona—Gila and Salt River Meridian

T. 7 N., R. 4 W.—Dependent Resurvey–Part

Idaho—Boise Meridian

T. 10 S., R. 21 E.—Supplemental Survey
T. 8 S., R. 22 E. (2)—Supplemental Survey
T. 9 S., R. 22 E. (4)—Supplemental Survey
T. 8 S., R. 24 E.—Supplemental Survey

Montana—Principal Meridian

T. 25 N., R. 7 E.—Dependent Resurvey–All
T. 25 N., R. 8 E.—Dependent Resurvey–Part
T. 25 N., R. 9 E.—Dependent Resurvey–Part
T. 33 N., R. 9 E.—Dependent Resurvey–Part
T. 33 N., R. 13 E.—Dependent Resurvey–Part
T. 33 N., R. 14 E.—Dependent Resurvey–Part
T. 24 N., R. 4 W.—Dependent Resurvey–Part
T. 24 N., R. 5 W.—Dependent Resurvey–Part
T. 25 N., R. 4 W.—Dependent Resurvey–Part
T. 25 N., R. 5 W.—Dependent Resurvey–Part
T. 22 N., R. 5 W.—Dependent Resurvey–Part
T. 21 N., R. 5 W.—Dependent Resurvey–Part
T. 21 N., R. 6 W.—Dependent Resurvey–Part

Nevada—Mt. Diablo Meridian

T. 15 N., R. 70 E.—Original Survey
T. 15 N., R. 71 E.—Original Survey

New Mexico—New Mexico Principal Meridian

T. 31 N., R 1 E.—Dependent Resurvey
T. 32 N., R. 1 E.—Dependent Resurvey
T. 10 N., R. 5 E.—Dependent Resurvey–Part
T. 11 N., R. 6 E.—Dependent Resurvey–Part
T. 31 N., R. 1 W.—Dependent Resurvey
T. 32 N., R. 1 W.—Dependent Resurvey
T. 27 N., R. 6 W.—Dependent Resurvey
T. 27 N., R. 7 W.—Dependent Resurvey
T. 25 N., R. 14 W.—Dependent Resurvey and Survey
T. 26 N., R. 14 W.—Dependent Resurvey and Survey
Ts. 13, 14, & 15 N., Rs. 16 & 17 W.—Wingate Ordnance Depot boundaries
T. 21 S., R. 7 W.—Dependent Resurvey–Part
T. 21 S., R. 8 W.—Dependent Resurvey–Part

North Dakota—Fifth Principal Meridian

T. 151 N., R. 65 W.—Dependent Resurvey–Part
T. 150 N., R. 66 W.—Dependent Resurvey–Part
T. 151 N., R. 66 W.—Dependent Resurvey–Part
T. 150 N., R. 67 W.—Dependent Resurvey–Part
T. 152 N., R. 67 W.—Dependent Resurvey–Part
T. 150 N., R. 68 W.—Dependent Resurvey–Part
T. 151 N., R. 68 W.—Dependent Resurvey–Part
T. 152 N., R. 68 W.—Dependent Resurvey–Part
T. 151 N., R. 69 W.—Dependent Resurvey–Part
T. 152 N., R. 69 W.—Dependent Resurvey–Part

Oregon—Willamette Meridian

T. 17 S., R. 8 W.—Dependent Resurvey–Part
T. 13 S., R. 4 E.—Dependent Resurvey–Sec. 36
T. 13 S., R. 5 E.—Dependent Resurvey–Sec. 31
T. 4 S., R. 14 E.—Dependent Resurvey–Sec. 33

Utah—Salt Lake Meridian

T. 38 S., R. 1 E.—Skeleton Survey
T. 39 S., R. 1 E.—Skeleton Survey
T. 40 S., R. 1 E.—Skeleton Survey
T. 38 S., R. 2 E.—Skeleton Survey
T. 39 S., R. 2 E.—Skeleton Survey
T. 40 S., R. 2 E.—Skeleton Survey
T. 36 S., R. 7 E.—Skeleton Survey
T. 37 S., R. 7 E.—Skeleton Survey
T. 23 S., R. 8 E.—Skeleton Survey
T. 32 S., R. 11 E.—Skeleton Survey
T. 33 S., R. 12 E.—Subdivisional Survey
T. 31 S., R. 13 E.—Skeleton Survey
T. 32 S., R. 13 E.—Skeleton Survey
T. 33 S., R. 13 E.—Skeleton Survey
T. 35½ S., R. 13 E.—Skeleton Survey
T. 31 S., R. 14 E.—Skeleton Survey
T. 32 S., R. 14 E.—Skeleton Survey
T. 32½ S., R. 14 E.—Skeleton Survey
T. 34 S., R. 14 E.—Skeleton Survey
T. 20 S., R. 15 E.—Skeleton Survey
T. 31 S., R. 15 E.—Skeleton Survey
T. 32 S., R. 15 E.—Skeleton Survey
T. 32½ S., R. 15 E.—Skeleton Survey
T. 30½ S., R. 16 E.—Skeleton Survey
T. 31 S., R. 16 E.—Skeleton Survey
T. 32 S., R. 16 E.—Skeleton Survey
T. 33 S., R. 16 E.—Skeleton Survey
T. 33 S., R. 17 E.—Skeleton Survey
T. 34 S., R. 17 E.—Skeleton Survey
T. 32 S., R. 19 E.—Skeleton Survey
T. 32 S., R. 20 E.—Skeleton Survey
T. 43 S., R. 6 W.—Small Tract Survey
T. 41 S., R. 10 W.—Extension Survey
T. 19 S., R. 19 W.—Dependent Resurvey
T. 19 S., R. 20 W.—Dependent Resurvey

Comment and Discussion

The pages of SURVEYING AND MAPPING are open to a free and temperate discussion of all matters pertaining to the interests of the CONGRESS. It is the purpose of this Department to encourage comments and published material or the presentation of new ideas in an informal way.
—EDITOR

STANDARDIZED COMPUTATIONS FOR SUBDIVISIONS

MAURICE GOULD*—I have read with interest the article submitted by Harold J. Welch, entitled "Standardized Computations for Subdivisions" as it appeared in your July–September 1957 publication.

This article was skillfully written, quite educational, and, I am sure, will be profitable to those organizations which will follow his suggestions. I was quite impressed with his conviction that the computer should keep in mind the problems in the field, fix his stations accordingly, and thereby keep field pins to a minimum. In this way, the working map is not only the result of abstract computations, but becomes a communicative instrument between the office and the field. I am sure that many surveyors can recognize the value of this relationship.

Once again, congratulations, and more articles of this type!

* 147–15 69th Road, Flushing 67, L. I., N. Y.

FINDING THE RADIUS OF AN EXISTING HORIZONTAL CIRCULAR CURVE

PHILIP A. LATIMER*—The article, "Interpretation of Deed Words," SURVEYING AND MAPPING, April–June 1957, pages 159–161, is very interesting reading to me.

Beginning at point *B* the above deed reads: "due West 1320 feet; thence, due North 2640 feet; thence due East 1320 feet; thence, due South 2640 feet. . . ." Hasn't the engineer forgotten to allow for the convergence of meridians? I realize that the problem, as to point *B* being 11 feet out, is a question of the difference between the azimuth brought in from the line C 31–C 32 and the true north.

Now, I would like to offer a suggestion as to the solution of a problem which is apt to occur more and more frequently as new highways are built on new locations.

Suppose that we are running out on the ground an old deed line which now crosses a curve of a new highway, and it is desired to ascertain the degree of curvature or the radius of curvature of the new centerline. (*See* Fig. 1.)

Lay off a chord (*AB*) of length 67.70 feet and measure the middle ordinate. The degree of curvature will then be 10 times the measured middle ordinate. As a check, lay off the chord (*AC*) of length 95.75 feet and measure the

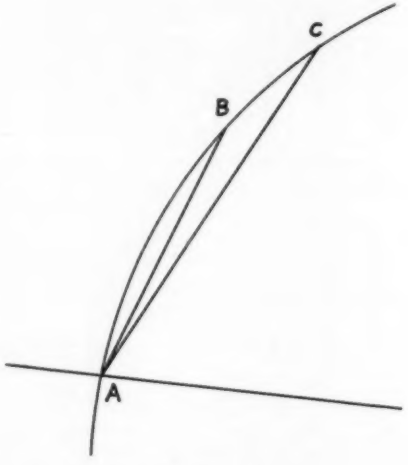

FIGURE 1.

* Route 2, Box 3, Edgewater, Md.

middle ordinate. The degree of curvature will then be 5 times the measured middle ordinate.

EDITOR'S NOTE:—When this letter was received, in July 1957, the editor became curious as to the relationship between this method and the one published in SURVEYING AND MAPPING, January–March 1956, Vol. XVI, No. 1, page 82, and undertook to experiment a bit. He kept coming up with certain small discrepancies—so small as to be of little practical importance, but disturbing nevertheless—and wrote to Mr. Latimer and requested a clue as to how the formulas had been derived.

It then developed that this is an *approximate* method, close enough for many practical purposes, to be sure, but becoming increasingly loose as the degree of curvature increases, or the radius of curvature decreases.

The derivation of the formulas** is given below. (*See* Fig. 2.)

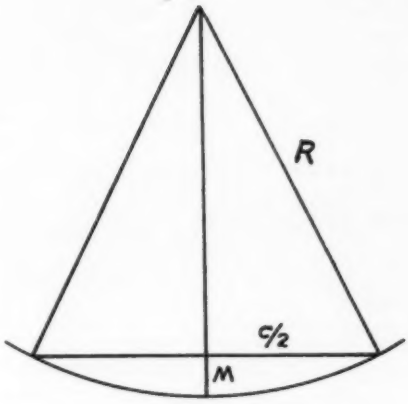

FIGURE 2.

From figure 2 it is obvious that

$$R^2 = (R-M)^2 + (C/2)^2$$
$$= R^2 - 2RM + M^2 + C^2/4$$
$$2RM = M^2 + C^2/4$$
$$R = M/2 + C^2/8M$$

Neglecting the small term, we have

$$R = C^2/8M \text{ (Approx.)}$$
$$D_{arc} = 5729.578/R = (5729.578 \times 8M)/C^2$$
$$= 45836.624\ M/C^2$$

If $45836.624/C^2 = 10$, $C = 67.70$, and if $45836.624/C^2 = 5$, $C = 95.75$.

** This derivation was checked by Cecil F. Ellingwood, Coast and Geodetic Survey, who is also an instructor in Route Surveying at the U. S. Department of Agriculture Graduate School.

A SUGGESTION FROM LEBANON

GEORGE E. KATTOUAH*—Forwarding the following for publication in our journal, I wish to thank you in anticipation. I look forward to being encouraged to write more for publication and will welcome any comments, corrections, or additions from you or from others.

WORKING FOR SUPERIOR CADASTRAL SURVEYING

Feeling that there is no opposition, in opinion, the writer believes that the *ideal* method for attaining a superior cadastral survey has not yet been established anywhere in the world. Many instruments and methods have been innovated by scientists and engineers, but, sorry to say, none have been devoted to the improvement of cadastral surveying systems. Photogrammetry alone will not do the job, the chain survey has become ancient and should be abandoned, the planetable is a thirdclass method, traversing is expensive, the Shoran and Tellurometer are not intended for this work, and thus it has been ignored.

Twelve years ago I carried out experiments in order to establish the cheapest and most precise method. I tried chain survey with a long-range optical square. The same plot was surveyed in a long-band combined traverse, where every boundary point was observed and traversed to in order to be coordinated. Again the same plot was resurveyed using, instead of the transit, a Zeiss self-reducing tacheometer. Time was recorded for completing the field work by each of the three methods. The last method was the fastest and required the briefest field notes, but, due to the expensive equipment, it could not be used on a large scale.

It has been the custom to use cheap methods of surveying cheap land, such as chain survey, planetable, or compass traverse; neglecting the fact that day after day the land is becoming more valuable. Many problems and disputes appear for which no concrete solutions are found, except amicable agreement, resurveying, or "blinding out" the discrepancies. This is more expensive in the long run than making a precise survey of the cheap land.

A boundary point without coordinates is like

* P. O. Box 393, Tripoli, Lebanon.

a cork floating in a pool. Eventually registration of title deeds will require coordinates for every boundary point with reference to a grid system, otherwise the position of such a boundary point would be "floating." If we feel any responsibility for the coming generation, we must insist now on coordinated surveys—though expensive now, they are cheap for the future.

These are only some hints for working out a plan for superior cadastral surveying which, if not accomplished by me, will someday be achieved by others. Many features of the presently known systems will have to be changed, using other kinds of instruments and equipment and other methods, and I will be glad to hear from any person (or firm) wishing to collaborate in working out the plan and who will write directly to me.

EDITOR'S NOTE:—The above letter, written in English by a new member of the American Congress on Surveying and Mapping—one whose native language appears to be Arabic—has required a very considerable amount of editing in preparation for publication. It is our sincere hope that, in making rather numerous editorial changes, we have not done violence to the ideas expressed. We hate to think what a horrible letter we would compose if required to use Arabic in lieu of English.

PAUL PFINZING—EARLY GERMAN CARTOGRAPHER

ENA L. YONGE*—Perhaps some of your readers would be interested in an article I found in *Erdkunde,* Vol. XI, Heft 2, Mai 1957, published in Bonn, Germany, under the auspices of Carl Troll, entitled "Pfinzing, ein vergessener kartograph" by Ernst Gagel. It is in German, but has a short summary in English, as follows:

"The purpose of the paper is to draw attention to an important German cartographer of the 16th century, the Nuremberg senator Paul Pfinzing (1554–1599). Pfinzing's importance lies in the field of topographic (medium scale) maps and further in the fact that he developed the system of surveying by means of a compass traverse. He wrote about his experiences as a cartographer in a book which was published in 1598. In it he explains in German all the fields of practical cartography from the making of the necessary instruments and the surveying in the field, to the construction of the map on the drawing board."

The article has nine illustrations taken from his book, and a striking map in color of part of "Amt Hersbruck, Ausschnitt Hohenstein, 1596" by Paul Pfinzing.

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* Map Curator, American Geographical Society, Broadway at 156th St., New York 32, N. Y.

Coast and Geodetic Survey Sailing and General Charts

Sailing charts are published by the Coast and Geodetic Survey at scales of 1:600,000 and smaller. The charts of this class are intended for use in fixing the mariner's position as he approaches the coast from the open ocean, or for coastwise sailing between distant ports. On these charts the shoreline and topography are characteristically generalized, and only offshore soundings and depth curves, the principal lights, outer buoys, and landmarks visible at considerable distances are shown.

To facilitate the plotting of lines of position determined by the Loran system of navigation, the Bureau has published representative Sailing charts with systems of Loran lines in distinctive colors. Three of these charts, designated Nos. 1000-L, 1001-L and 9000-L, are printed with Loran lines and depth curves, but without offshore soundings, on the reverse of conventional Sailing charts 1000, 1001 and 9000, respectively.

General charts are intended for coastwise navigation offshore of outlying dangers. They are published at scales of 1: 100,000 to 1: 600,000. The typical General chart depicts only a narrow belt of topography, while hydrographic detail inside of the entrances to major rivers and bays is omitted entirely. Offshore submarine relief is adequately delineated by sufficient depth curves to permit the use of the fathometer profile as an aid to navigation, possibly in conjunction with visual or radio bearings, or Loran lines of position. These systems of Loran lines are charted in color on 16 of the General charts, covering the areas where Loran is available, and where the Loran coverage on the corresponding Sailing chart can be supplemented to advantage. Lack of Loran facilities in the Gulf of Mexico west of the Mississippi delta precludes charting of Loran lines on charts of that area.

Sailing and General charts of the United States and its possessions are for sale by the Coast and Geodetic Survey or its agents at prices of fifty cents, seventy-five cents, or one dollar, depending upon size.

News of Related Organizations

Missouri Association of Registered Land Surveyors

CHARLES C. REDMAN, JR.*—You will remember that some time ago we had some correspondence relative to the organization of a Section in the State of Missouri. I wrote to each member of the Congress in the State of Missouri at that time and received a very good response. It was at about that time, however, that we initiated a movement to secure the registration of land surveyors in the State of Missouri.

I have not noticed any information relative to the fact that the State of Missouri now has a Registration Law for land surveyors in any issue of SURVEYING AND MAPPING, and I thought you might be interested in the fact that, in addition to having secured a Registration Law for surveyors in the State of Missouri we now, also, have organized the Missouri Association of Registered Land Surveyors which has become quite active and which now has more than 50 percent of the registered land surveyors in the State as members, even though we have been in existence only a few months.

The Missouri Association of Registered Land Surveyors has already taken, in my opinion, several constructive steps:

(1) The issuance of a handbook for land surveyors in Missouri, and

(2) The filing of a request (and probable adoption) that a course, in at least one of our State colleges, be given in Land Surveying, with the college issuing a Certificate of Completion therefor.

The officers of the newly organized Missouri Association of Registered Land Surveyors are:

President—T. C. Horstmann, Jefferson City,

Vice-president—C. C. Redman, Jr., Kennett,

Secretary-Treasurer—D. A. Brown, Jefferson City,

Directors—G. H. Kastendieck, Springfield; G. W. Pritchard, Independence; and H. L. Steele, St. Louis.

Executive Secretary—P. N. Doll, P. O. Box 355, Jefferson City, Mo.

—EDITOR

* Vice President, Missouri Association of Registered Land Surveyors, P. O. Box 355, Jefferson City, Missouri. Letter addressed to Executive Secretary, ACSM.

Tenth Annual Meeting of the Virginia Association of Surveyors

The Tenth Annual Meeting of the Virginia Association of Surveyors convened on January 24 and 25, 1958, with over 80 surveyors, plus wives and guests, enjoying the snow-covered hospitality of the Ingleside Resort at Staunton.

Most of the members arrived on Friday afternoon in a blinding snow storm. The weather matched the mood of the surveyors who, having lost the first round in a court case that threatened the livelihood and future of surveying in the Commonwealth of Virginia, were determined to come to grips with legislative remedies.

The Friday evening social gathering was sprinkled with clusters of members discussing the pros and cons of a proposed bill that the VAS Legislative Committee had caused to be prepared for submission to the Legislature.

The Saturday morning session opened with the report of Secretary Jack Bartenstein. This report showed that of the 380 licensed Land Surveyors residing in Virginia (this figure includes about 100 also licensed as Professional Engineers) 155 belonged to VAS. This represents a vast majority of the practicing offices in the State.

It was noted that during the year a Tidewater Chapter had been formed, and that VAS had been successful in promoting a member of this new chapter, Frank Terrall, to fill a vacancy that had occurred on the State Examining Board.

It was also noted that VAS had, in conjunction with ACSM, conducted a successful "Surveyors' Day" at Williamsburg, in connection

with the 350th anniversary of the founding of Jamestown, but had thus far failed in efforts to have a Surveyor Commemorative stamp issued (this also in connection with ACSM). The above activities were, of course, in addition to the time consumed in preparation for the court case and the legislation.

Following the above report, the meeting went into a discussion of proposed legislation. President Maher ruled that no motions would be made during the morning session, and, after the report was read by Chairman Jim Payne, representatives from each chapter and the membership-at-large were given full opportunity to present their views on the proposed bill.

The meeting adjourned for luncheon, at which time Staunton's Vice-Mayor R. W. Smith welcomed the group and Dr. J. L. Gibbs, rector of Emmanuel Episcopal Church, spoke to the group on the importance and dignity of the ancient profession of surveying.

The afternoon session began with the three chapter groups and the at-large group sent into caucus to discuss an agreeable bill. At 3 p.m., the meeting re-convened and Mr. Ben Clark moved that the bill include, in addition to general surveying of areas and establishment of boundaries contained in most States' definitions, the "plotting of land and subdivisions thereof include topography and contours, setting forth grades and determining drainage and providing for small drainage structures and such other incidental engineering as may be required by local authorities or conditions." In addition, the motion contained a clause that the State Examining Board "shall have the authority to regulate the professional conduct of the practitioners of their (architects, engineers, and land surveyors) respective professions." After the motion was seconded, President Maher called for discusssion. There was none. The vote was called for and, in breathless silence, hands were raised for the "ayes." No hands were raised for the "nays." Surprise, almost amounting to shock, followed a moment of silence and then tension was released with a spontaneous hand clapping.

Other business of the day also passed with unanimous votes and included endorsement of three VAS past presidents to fill a vacancy on the Examining Board that will occur in June and a resolution that requested persons appointed as "County Surveyors" to refrain from using this title when doing "private" work. (In this connection, it was pointed out that the Attorney General had ruled that no "County Surveyor" could do work other than upon Court orders or directly as employed by the County unless he was also a Certified Land Surveyor. There are still about seven non-certified County Surveyors in the State. However, some County Surveyors who are also certified are using the title on all work presented to clients, whether or not connected with their official positions.)

Following the business session, Clifford Thorpe, Chairman of the Instruments Division of ACSM, presented the technical part of the meeting. Mr. Calvin Maltby, Assistant Chief, Field Surveys Section, Geological Survey, Washington Staff, spoke on "New Rod Facings and Reticule Designs." Mr. Henry D. Walker, Acting Chief, Geodesy and Control Surveys, Topographic Division, Geological Survey, discussed "Control Surveys and Some Late Developments in Surveying Instruments." Mr. Milton E. Compton, Berg, Hedstrom & Co., discussed "Accurate Measurement of Short Distances with Light Transmission Using the Model 4 Geodimeter."

The evening Annual Banquet included presentation of prizes and a showing of color slides of historical instruments displayed at "Surveyors' Day." The pictures were taken by Carl Gardner and narrated by Clifford Thorpe. President Maher installed the incoming officers and directors. The elected officers were Robert Bartenstein, *President;* Victor Ghent, *Vice President;* and re-elected Jack Bartenstein, *Secretary-Treasurer;* and two-year *Director* A. L. Cherry.

VICTOR H. GHENT

NOTE: As of the writing of this report, the Surveyors Bill, in a much reworded condition, but presumably containing the original intent, had just passed the House Committee on General Laws and was ready for the House vote. If it passes that vote, it will go to the Senate Committee and then to the Senate and then to the Governor. A long row to hoe!

Second International Cartographic Conference

Rand McNally & Company will be host to cartographers and map reproduction experts at Northwestern University, Evanston, Ill., June 15–21, 1958. ACSM's Cartography Division sponsors activity for the group in Washington, D. C., June 23–27. Programs are planned of interest comparable to the first Esselte Conference held in Stockholm in 1956.

CONGRESS NEWS

Northern California Section Holds Fourth Annual Workshop

One hundred fifty members and guests of the Northern California Section of ACSM registered for the Fourth Annual Surveyors Workshop, held at the Casa Munras Hotel in Monterey on November 2, 1957. Included were several guests from the Southern California Section. The constantly increasing attendance at these annual events attests to their value and importance and to the growth of the Section and the profession in northern California.

After a luncheon in the Fiesta Room, Workshop Chairman C. A. Wooldridge opened the technical session by reading a resolution which he and Leo Ruth had prepared for presentation to the California Senate Interim Committee. The resolution, dealing with proposed changes in the Business and Professions Code as it applies to surveyors, was approved by voice vote of the Section members.

Secretary-Treasurer William A. Angeloni then presented his annual report. His request that action be taken to raise the limit on funds on hand above the existing figure of $500 was approved.

A report on the progress of surveyor education in the colleges and universities was presented by Prof. C. J. Aggeler of the City College of San Francisco.

"Electronic Computing in Surveying and Mapping" was the title of an informative paper presented by Lyle Turner of Electronic Calculating Services, Inc., of Los Angeles. Mr. Turner stated that, for a fee of $7.50 per hundred courses, his firm will compute cosines, sines, latitudes, departures, and closure ratios, and make the adjustments, provided the field observation data (courses and distances) are submitted on special machine sheets available from the company.

Robert Suelflohn of International Business Machines, Los Angeles, spoke on the several machines manufactured by his firm and their application to surveying and engineering. He pointed out that, because the machines are very expensive, they are usually rented out on a monthly basis for operation by specially trained personnel.

As part of a panel discussion on the Federal Highway Project, H. L. Clausen, Projects Engineer, U. S. Bureau of Public Roads, discussed the activities of the Bureau and its part in the thirty-million-dollar national road construction program. A. C. Birnie, Senior Engineer, California Division of Highways, continued the discussion with an outline of the planning and progress of highways in the seven Bay Area counties. Indicative of the scope of the planning in this area is the somewhat startling fact that the planning extends to the year 1995. Concluding the discussion on the Federal Highway Project, Prof. Aggeler read portions of a letter from Capt. W. M. Gibson, U. S. Coast and Geodetic Survey, San Francisco, which explained the work to be done by the Bureau in connection with this project.

Among important items of business discussed by the Executive Board at a meeting prior to the opening of the technical sessions were the following: (1) Publication of a booklet-form list of ACSM members in northern California, (2) establishment of a scholarship in surveying at one of the northern California colleges or universities, and (3) exploration of the possibility of expanding the Surveyors Workshop into a West Coast regional meeting in conjunction with the American Society of Photogrammetry.

At a well attended social gathering and dinner dance, held in the Fiesta Room, newly elected officers of the Section were installed.

The C. A. Wooldridges were once again generous hosts at an open-house coffee on the departure morning, Sunday.

Cory Hall, on the campus of the University of California in Berkeley was the scene, on December 6, 1957, of a regular meeting of the Northern California Section of ACSM. About fifty members and guests were present.

Junior Past President Harley A. Waterfall,

in charge of the meeting, introduced the speakers: Francis H. Moffitt, Associate Professor of Civil Engineering and Harry Silvis, Physical Standards Laboratory, University of California. With the aid of a projector and slides the speakers described and explained the University's tape comparator. With this equipment, six separate calibrations of 100-foot tapes can be made. The University provides this service to surveyors for a fee comparable to that of the National Bureau of Standards.

After the talk, the group adjourned to the tape test range where the speakers demonstrated the calibration of a tape owned by one of the surveyors present.

Announcement was made at the meeting concerning the Fourth Annual Meeting of the Southern and Northern California Sections of ACSM, to be held May 2 and 3, 1958, at Santa Barbara.

—Paul J. Dowling
Section Editor

Southern California Section

More than a hundred members of the Southern California Section and their friends availed themselves of the opportunity to learn more about the application of electronic computing to surveying problems, by attending a lecture and demonstration on the IBM Electric Computer. This informative program, given in one of the IBM classrooms in Los Angeles on three successive evenings, Sept. 18, 19, and 20, 1957, was presented by William Lull of IBM.

After a preliminary discussion of computing in general and specific discussions of two IBM computers, Mr. Lull demonstrated traverse closures and least square adjustments of triangulation networks using the computer.

Announcement was made at the meeting that the Joint Meeting of the Northern and Southern California Sections would be held at Santa Barbara, May 2–4, 1958.

The fall meeting of the Section, held in the evening of Oct. 24, 1957, at the General Petroleum Corporation auditorium in Los Angeles, was highlighted by an enlightening talk on "Adverse Possession" by Harold Arman, Vice-President of the Title Insurance and Trust Company. The sixty members and guests present indicated their interest in the subject by the numerous questions asked from the floor after the talk.

Four short motion pictures rounded out the program. In one of these the audience was taken on a rocket trip far into space to see the curvature of the earth.

—Reynold L. Pedersen
Section Editor

After months of painstaking work the Southern California Section has just published a "Research Manual of Surveying and Mapping Information of Southern California."

This 32-page pamphlet gives, for each of the eleven counties and municipalities in the area, complete information as to the office of record or information for (1) surveys of streets, roads, railroads, and their rights-of-way; (2) recorded maps, plots, boundary and subdivision surveys, and township and section surveys; (3) surveys of water, gas, sewer, irrigation, and power lines; (4) geodetic control data; and (5) many other similar kinds of information. The mail and street addresses of each record office are also listed.

Compiled by a research committee headed by Don P. Jones and printed by the Title Insurance and Trust Co., this valuable booklet is available free to all paid-up members of the Southern California Section.

Officers and directors of the Section for 1958 are as follows:

Harvey E. Rookus, *Chairman*
Albert V. Cocking, *Vice Chairman*
Reynold L. Pedersen, *Secretary*
Joseph J. Cooper, *Treasurer*
R. T. White, *Editor*
Forrest M. Burke, *Director*
A. Clarence Johnson, *Director*
Robert J. Kadow, *Director*
Selwyn Douglas, *Past Chairman*

—R. T. White
Section Editor

Texas Section

The year 1957 was a very successful year for the Texas Section. Under the leadership of Chairman William J. Warren, four excellent meetings were held, including the annual meeting on December 6, 1957. Tom Dillon served as Chairman of the Program Committee for the year.

More than 80 members and guests attended the annual meeting, which was held at Kaphan's Restaurant in Houston. In the absence of Mr. Warren, First Vice Chairman Cecil J. Foster presided at the occasion, which included a social hour, a splendid dinner, and the annual business meeting.

Officers and directors elected for 1958 are as follows:

Leonard Cornitius, *Chairman*
Tom Dillon, *1st Vice Chairman*
L. P. Carr, *2nd Vice Chairman*
John O. Phillips, *3rd Vice Chairman*
Glenn E. Musselman, *Secretary*
Howard E. Bush, Jr., *Treasurer*
Robert E. Crosser, *Director*
John C. Lipscomb, *Director*

—HODGE E. MASON
Section Editor

North Carolina Section of ACSM Formed

Following ACSM approval of a petition by North Carolina members, the North Carolina Section of ACSM was formed at its organizational meeting at 2:00 p.m., Thursday, January 9, 1958, in the Salem Room of the Robert E. Lee Hotel, Winston-Salem, N. C. The following officers were elected:

Chairman—Benjamin E. Kirkman, R.L.S., Duke Power Company, Charlotte, N. C.

First Vice Chairman—Robert P. Guarino, P.E., 336 South Wren St., High Point, N. C.

Second Vice President—Mack M. Lewis, R.L.S., 230 Asheville St., Morganton, N. C.

Secretary & Editor—W. Thompson Cox, P.E., P.O. Box 178, Gastonia, N. C.

Treasurer—Fred B. Davis, R.L.S., 148½ Brevard Court, Charlotte, N. C.

Edgar H. Kimmons, P.E., of 101 North Gregg St., Charlotte 8, N. C., who acted as secretary to the petitioners, was appointed temporary chairman by ACSM President Lyddan to organize the above meeting. Mr. Kimmons has been designated as the Authorized Representative of the North Carolina Section and appointed Liaison Representative with ACSM.

IBM 650 for Highway Computations

Automatic digital computers, such as the one shown at the right, can quickly solve engineering problems related to highway construction. It was on this premise that J. James Stone, Chief of the Battelle Memorial Institute's Systems Engineering Division, recently organized the first Battelle-sponsored Workshop on Highway Engineering Applications of Automatic Computers. It was pointed out that at present a real limiting factor in how quickly the Nation's highway system can be improved is not in the actual physical construction, but in the engineering and design work that must precede ground-breaking.

Some of the twenty state highway officials and consulting engineers participating in the Workshop, which ended October 4, 1957, are shown working at one of the IBM 650 computers at the Columbus, Ohio, research center. Members of the Battelle staff—assisted by representatives of The Ohio State University, Photronix, Inc., and the State of Ohio Highway Department—demonstrated the use of computers to solve such problems as cut-and-fill, right-of-way, geometrics, and pier stress analysis.

Annual Financial Statement

(As of December 31, 1957)

INCOME

Dues and memberships received	*1956*	*1957*	*Year ending 12/31/56*	*Year ending 12/31/57*	*Difference*
Individual	3885	4067	$19,657.20	$20,408.13	+$ 750.93
Library	426	524	1,992.59	2,446.50	+ 453.91
Sustaining	18	24	575.00	625.00	+ 50.00
Previous year's dues			179.00	402.00	+ 223.00
Total	4329	4615			
Total gross regular income			$22,403.79	$23,881.63	+$ 1,477.84
Deduct membership costs			– *1,484.06*	– *2,453.39*	– *969.33*
Net regular income			20,919.73	21,428.24	+ 508.51
Publication sales			304.56	494.83	+ 190.27
Advertising			4,099.99	4,667.40	+ 567.41
Other income			816.44	1,390.58	+ 574.14
Annual meeting			4,696.30	6,731.22	+ 2,034.92
OPERATING INCOME			$30,837.02	$34,712.27	+$ 3,875.25

EXPENDITURES

Journal (all expenses)	$16,870.93	$15,397.97	–$ *1,472.96*
Salaries and Office Expense		4,293.63	+ 4,293.63
Secretary's, Treasurer's and Librarian's expenses	1,109.74	3,033.56	+ 1,923.82
Technical Divisions	262.52	414.34	+ 151.82
Other expenses authorized by the Board of Direction	3,189.14	400.00	– *2,789.14*
TOTAL EXPENDITURES	$21,432.33	$23,539.50	+$ 2,107.17
NET INCOME	$ 9,404.69	$11,172.77	+$ 1,768.08

ASSETS

Bank balance	$ 9,718.16	$23,667.61	+$13,949.45
Bonds and Savings Accounts	40,047.36	46,307.75	+ 6,260.39
Property	764.56	3,102.07	+ 2,337.51
Advance payments	760.96	41.28	– *719.68*
Accounts receivable	1,400.00	1,200.00	– *200.00*
TOTAL ASSETS	$52,691.04	$74,318.71	+$21,627.67

LIABILITIES AND NET WORTH

Advance dues paid	$ 1,309.03	$11,092.67	+$ 9,783.64
Accounts payable	4,000.00	4,671.26	+ 671.26
TOTAL LIABILITIES	$ 5,309.03	$15,763.93	+$10,454.90
NET WORTH	$47,382.01	$58,554.78	+$11,172.77

JOHN M. AMSTADT, *Chairman*
Budget and Finance

NEW MEMBERS

INDIVIDUAL MEMBERSHIPS

AAROE, Eugene, 6502 185th St., S.W., Lynnwood, Wash.—Surveyor, N. Henry Gellert & Associates

AGUIRRE, Jorge Sotomayor, P.O. Box 4755, Ecuador, S.A.—Draftsman, Empresa Electrica del Ecuador, Inc.

AMESBURY, Kenneth, 1148 Bryant Ave., Bronx 59, N. Y.—Student

ASHEY, 1st Lt. Clarence D., Jr., 524th Engineer Co. (Topo), APO 403, New York, N. Y.—Supply and Maintenance Officer

BATES, Carleton J., 20 Lakeview Dr., Norwalk, Conn.—Chief of Party, Raynor Aerial Surveys

BAUER, William J., Meissner Engineers, Inc., 300 West Washington St., Chicago 6, Ill.—Senior Project Engineer

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Further Comments on the Relationship of Forestry and Land Surveying*

By LOUIS N. A. SEEMAN**

CHIEF SURVEYOR, OLIN MATHIESON CHEMICAL CORPORATION

Being both a graduate forester and a registered professional land surveyor, I would like to comment on the proposed registration of professional foresters. I am entirely in favor of the registration of all foresters who do any work that in any way affects the pocketbook of the public, either present or future. But I do feel that a forester should be limited in his field of activity, especially as pertains to surveying.

I see no real reason for amending any of the State laws on licensing or registration of land surveyors. The only change that may be needed would be in the definition of professional land surveyor and/or forester. A forester's activities actually encroach more on the real estate agent's field than on the surveyor's field.

Of course the forester must know the boundary of the land in his charge to limit the cultural activities necessary for the growing and harvesting of a timber crop. And as mentioned, he must be able to determine if the number of acres he is dealing for in a purchase are actually available as described.

A forester must be taught surveying, if for no other reason than to give him some "land sense." We aren't all fortunate enough to have been reared on a backwoods farm. He needs to know where to look for corners and boundary lines, as he works across the property that is in his charge. He must be able to recover lines where they become partially obliterated by logging, fire, or storms. He must know enough about surveying to reset a corner, should it be "drug out" by skidding a log over it. He should also be able to determine whether or not a survey is erroneous, and approximately how much.

All the surveying a forester is likely to be called upon to do will either be a retracement of an older survey or a subdivision of such a survey. As long as the forester confines his surveying to the freshening or retracing of old surveys, he will never encroach upon the surveyor's work.

However, should the freshening or retracing of a line bring on a controversy or threat of controversy between land owners, then the problem is strictly in the realm of the land surveyor. If the sickness is too serious for first aid, call a doctor.

Foresters know wood identification and soils and can identify the kind of tree that stood on a certain spot. The length of time this can be determined depends on the species and whether or not the stump burned. The soil will show the location of a tree, and often the location of a post set for a corner. Foresters also have a good knowledge of how long it has been since a creek or road has been changed.

A surveyor is better trained in technique and usually understands all types of error better. He has a better sense of the legal and conformable aspects of a survey. Most engineering schools give a better background of law than do forestry schools, both as to procedure and as to the precedence of monumentation and other evidence.

Most surveyors are better trained in how to handle various surveying instruments, their capabilities and the means available for checking the results of their work. This means that a surveyor will be able to better describe points on the ground, or inversely, to better locate on the ground points described in a deed.

If all surveyors could find and identify evidence and monuments as well as foresters can, their training would be considerably better than it now is.

My suggestion is that the foresters confine their work to resetting corner posts and retracing marked land lines, and of course, measuring the length of all retraced lines and determining the bearing thereof. But if a line cannot be retraced, or if a controversy arises, then call in a registered professional land surveyor and help him find all the available evidence.

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MORE CONFUSION?

A short article in *Civil Engineering,* February 1958, page 96, bearing the title "Consultant Held Not Subject to Fair Labor Standards Act" would seem to indicate that the last word has not yet been said in the matter of whether or not plans and specifications are "goods for commerce."

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A newly-developed sea gravimeter was used to make the unprecedented surface measurements. The instrument was mounted on a gyro-stabilized platform installed aboard the USS *Compass Island*. Previously, gravity values for ocean areas had to be measured in submarines submerged to quiet depths.

The difficulty of obtaining and fitting submarines for this purpose reduced to a minimum gravity data for the 80 percent of the earth's surface that is covered by water. The new sea gravimeter, developed by Anton Graf of Munich, Germany, now makes it possible to take gravity measurements simply and expeditiously any place on the ocean surface and thus assures that data long needed but difficult or impossible to obtain will now be available.

To date there have been only about 4,000 measurements of gravity at sea made throughout the world. Roughly half of these have been made by the Lamont Geological Observatory in the past 10 years, using pendulums carried in submarines.

The USS *Compass Island* left New York November 18 and returned November 22. The surface gravity measurements were begun 200 miles southeast of New York on November 22. They were continued on a track moving from the deep ocean basin across the continental slope and onto the continental shelf, ending off Long Island.

Data obtained with the new gravimeter on the surface were checked against readings made in the same area aboard the submarine USS *Tusk* in 1947.

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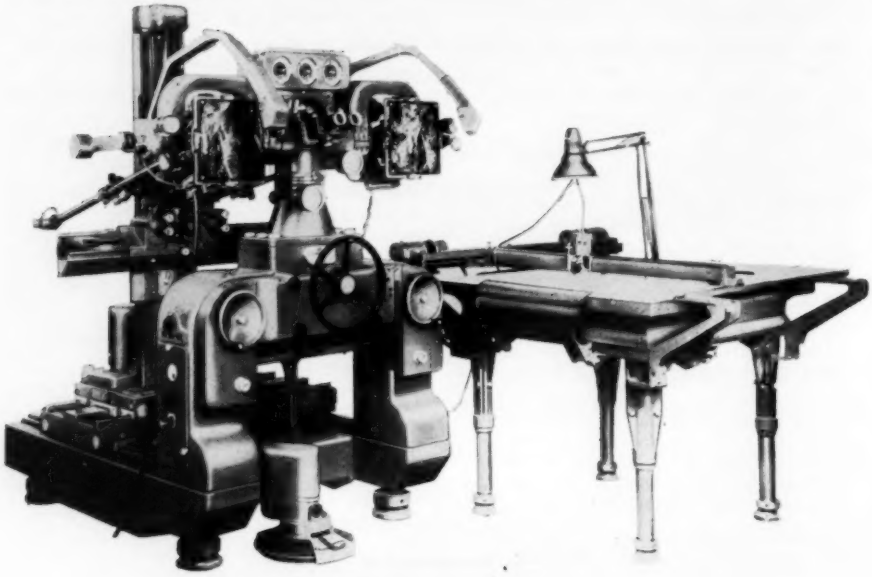

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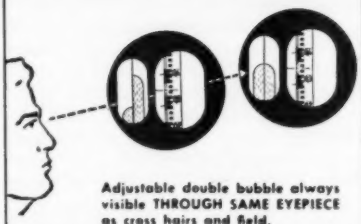

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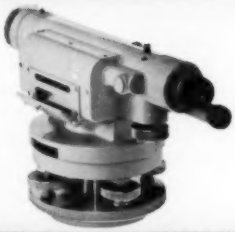

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TELLUROMETER SCORES AGAIN

In a test demonstration held near Doylestown, Pa., November 13, 1957, engineers of the Aero Service Corporation, using Tellurometer equipment, measured a line 27,414 feet in length to an accuracy of four inches or better (1 part in 82,000 or better) in about an hour. It was estimated that the measurement of this line by conventional methods would have taken a three-man party at least two days—and the accuracy, in all probability, would have been considerably less than that attained by the use of the Tellurometer.

NEW EDITOR FOR "CALIFORNIA HIGHWAYS AND PUBLIC WORKS"

Kenneth C. Adams, Editor, *California Highways and Public Works,* having reached the mandatory age for retirement, has had to relinquish the editorship of that magazine. The new editor, Richard Winn, who took over with the November–December 1957 issue, is a graduate of the University of California and was a reporter with the Oakland *Tribune* until the outbreak of World War II. He served with the Navy until retired from active duty with the rank of Commander. His experience in newspaper work and in public information work with the Navy form an excellent background for service in the new post, which was attained as a result of a civil service examination.

TO MOVE OR NOT TO MOVE

Surveyors are often called upon for unusual chores. In the southwest section of Washington there was a liquor store. The area is slated for redevelopment and the liquor dealer must go out of business or relocate his store.

The success of his fourth attempt to relocate hinges on the findings of the District Surveyor's Office.

It seems that a rival liquor dealer, located only a few blocks from the propossed address for the relocated store, is opposing the application on the grounds that his store can well handle all the trade in the area and that the owners of 76 percent of the property within the prescribed six-hundred-foot radius are opposed to the relocation.

The District Alcoholic Beverage Control Board has called upon the District Surveyor to check on the matter. If he finds that 51 percent of the land within the prescribed radius is owned by parties opposing the relocation, the application will have to be denied.

Captain John Smith's Map of Virginia

An attractive facsimile of Captain John Smith's famous map of Virginia—reproduced from an engraving in the Library of Congress—went on sale at the Library, May 16, 1957, with the formal opening of an exhibit celebrating the 350th anniversary of Jamestown, Va.

The facsimile may be purchased for $1.75 at the sales desk in the Library's Main Building or by mail from the Card Division, Library of Congress, Washington 25, D. C. (Checks should be made payable to the Treasurer of the United States. This publication cannot be charged to established accounts in the Card Division.) Produced by collotype on fine, imported paper, the facsimile measures approximately 16 by 19 inches and is suitable for framing. A brochure on the history and importance of the map accompanies it.

Captain John Smith's Map of Virginia is the first facsimile to be published with funds from the Verner W. Clapp Publication Fund. Members of the staff of the Library of Congress established the fund in October 1956 as a gift to their institution; its purpose—to honor the fund's namesake in farewell.

When Verner W. Clapp resigned as Chief Assistant Librarian to become President of the Council of Library Resources, Inc., his coworkers chose to realize one of his pet enthusiasms as a tribute to him and his 33-year career in the Library of Congress. A bibliophile with unflagging interest in fine typography, Mr. Clapp had an enduring wish to share the Library's treasurers with the public through facsimiles. He had always wanted to make information about its rare books, prints, maps, and manuscripts widely available through self-supporting publications—in short, through revolving funds that could continue to be used to reproduce the Library's fine materials in American history, art, and science. The facsimile of John Smith's map is the first realization of that wish through the staff's gift to the Library.

Published in 1612, Smith's map was the first to show the coast and inland regions of Virginia, Maryland, and part of Delaware in detail and hence is among the significant records of colonial America. The surveys and explorations incorporated in it are a vital and exciting part of the Jamestown story. Among the band of men who landed there on May 14, 1607, to establish the first permanent settlement in North America, Captain Smith—the only one now popularly remembered—was under arrest. Soon cleared of the charges, he became a leader in the colony and headed an exploring party that surveyed the inland wilderness. His dramatic exploits have been well publicized, but not his tangible and lasting contributions to American historiography and cartography. His vivid descriptions of the Virginia colony were recorded in letters, books, and pamphlets, and his detailed and remarkably accurate map of Virginia is a treasured heritage.

Engraved by William Hole, the original map went through numerous editions, and a number of additions and modifications were made on the engraved plate during the twenty years after the first printing. The engraving from which the Library's facsimile is reproduced in exact detail contains changes probably made on the plate in 1624. Besides presenting the topographical features, it is adorned with an illustration of the interior of Chief Powhatan's lodge, a sketch of one of the Sasquesahanock Indians, the royal coat of arms, Smith's coat of arms, a sea monster, and a sailing vessel.

Kargl Company, Inc., Special Bulletin No. 2

We have received a copy of "Special Bulletin No. 2" recently issued by the Kargl Company, Inc., of San Antonio, Texas, which appeals to us as a nice idea. We quote the first paragraph of this one-page bulletin.

"The purpose of this bulletin is to answer many requests for a list of information sources pertaining to Photogrammetry and Aerial Surveying and Mapping in general. We hope this information will be of value to you."

There follows a list of six books, with necessary information as to source and price; information about the American Society of Photogrammetry and the American Congress on Surveying and Mapping; information about *Photogrammetric Engineering* and SURVEYING AND MAPPING; a note on a publication regarding photographic materials; and a note concerning the U.S.G.S. "status maps" on aerial photography and topographic mapping.

A lot of useful information and all on one letter-size sheet. —EDITOR

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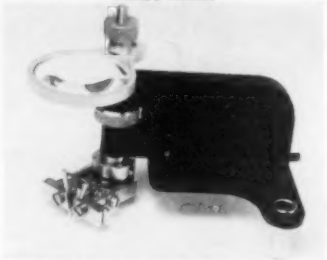

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President of the United States Wants Reports Clarified with Maps

President Eisenhower orders the Central Intelligence Agency to clarify daily intelligence digests by use of maps and red arrows if busy top level administrative officers are expected to read them.

The above action is reported taken recently, following a complaint by CIA that the Administration was ignoring the intelligence agency's findings. The President is reported as saying the reports were ponderous and requested that the scholarly digests be redrafted in more popular and brief text style, with the subject areas of discussion outlined on maps and with strategic points spotted with red arrows. Director Dulles of CIA was assured by President Eisenhower that briefer summarized reports with explanatory maps would be reviewed daily by the Administration's top policy makers.

Last year, Nelson A. Rockfeller, chairman of the President's Advisory Committee on Government Organization, suggested reviving the White House's World War II Map Room to facilitate the Administration's understanding of fluctuating world problems, feeling that the use of maps would dramatize and more graphically express both military and economic situations.

It has often been expressed by ACSM proponents of map use that many reports and project analyzations could well be supported with map information to facilitate better and more comprehensive understanding in matters of magnitude and complexity concerned with financial and operational administration matters of industry or government. The cold facts of words and figures become graphic with charts and maps.

—Walter S. Dix
Executive Secretary, ACSM

Announcing

ACSM Western U. S. Regional Meeting

October 10-11, 1958

to be held at

County Fairgrounds Auditorium
Monterey, California

Aimed at the interest and attendance convenience of ACSM members located in the western regions of the United States who do not regularly have opportunity to attend ACSM annual conventions in Washington, D. C., the Western Regional Conference and Exhibit is planned in conjunction with ACSM Northern California Section's Fifth Annual Surveyor's Workshop, which, staged in one of the West Coast's popular resort and convention centers, has become a well attended yearly event. Attractive as a vacation spot, the Monterey Peninsula area, located between San Francisco and Los Angeles, is noted for deep sea fishing and other recreational advantages including several famous golf courses, one of which—Pebble Beach—was recently seen featured on television during the Bing Crosby tournament by viewers across the nation. A cordial invitation extends to ACSM members, north, south, east, and west, and their friends, to combine professional business with pleasure while attending this convention on the Pacific Coast.

Meeting arrangements are well under way, spearheaded by ACSM Vice President George C. Bestor and the ACSM Northern California Section, whose chairman, Charles O. Greenwood, announces the following committee chairmanships:

General Chairman—George C. Bestor, P. O. Box 3045, Carmel, Calif.

Local Arrangements—C. A. Wooldridge, Jr., Carmel, Calif.

Program—C. J. ("Mike") Aggeler, San Francisco, Calif.

Publicity and Attendance—William A. White, Sacramento, Calif.

Exhibits—John Eaton, San Francisco, Calif.

Program items under consideration include field demonstrations of latest surveying equipment; review of national issues of professional interest to surveyors, including discussion of recently distributed first and second interim reports on status of surveying; and presentation of technical subjects in all branches of surveying and mapping and related sciences.

Bibliotheca Cartographica

Bibliotheca Cartographica is a new international biblography of cartographical literature which will be welcomed by all researchers in this field. It is compiled under the joint editorship of Karl-Heinz Meine, (Frankfurt a/M), Dr. H. Kramm (Marburg), and Dr. R. D. Schmidt (Remagen), and published by the German Bundesanstalt für Landeskunde, Remagen. Contributing editors are listed for Belgium, Germany, France, Italy, Yugoslavia, Austria, Poland, Sweden, South Africa, South America, and the United States.

This serial sponsored by the German Gesellschaft für Kartographie, is planned for semi-annual publication, but the first issue (1957) includes numbers 1 and 2. It includes 950 entries arranged under twelve major subjects (e.g. General Publications, History of Cartography, Applied Cartography, Use and Application of Maps, etc.). The table of contents is in English, French, and German.

Entries in the volume in hand range in date from 1954 through 1956, and supplement listings in Kosack, H.-P. and Meine, K.-H. *Die Kartographie 1943. Eine bibliographische Untersicht* (Lahr/Schwarzwald, Astra, 1955).

The classified arrangement of the entries is supplemented by an alphabetical list of authors. The serials cited most frequently are also alphabetically listed.

WALTER W. RISTOW

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